D3168
DEC 16 1881
SMITHSONIAN

THE AMERICAN

GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME XXXIV.—No. 12.
Whole No. 528.

NEW YORK, THURSDAY, JUNE 16, 1881.

$3 PER ANNUM
IN ADVANCE.

A. M. CALLENDER & CO., Proprietors.
G. WARREN DRESSER, C.E., Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND CLASS MATTER.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European Countries, $3.50 (15 shillings—18 francs). All payments to be made in advance. Single copies, 15 cents.

Remittances should be made either by post-office order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

Collections are invariably made directly from this office, for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

Correspondence.—Wishing to make this Journal a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of these subjects a pleasure or a profession.

Books.—We will mail, post-paid, at publishers' lowest rates, any book—scientific or otherwise—to any address in the United States or Canada. No books will be sent C. O. D.

The American News Company, Nos. 39 and 41 Chambers Street, New York, are agents for this Journal. Newsdealers will send orders to them.

CONTENTS.

☞ An asterisk (*) denotes an illustrated article

American Gas Light Association..... 265

EDITORIALS—

The Construction and Reconstruction of Gas Works..... 265

Partial Darkness in New York..... 266

The Petroleum Outlook..... 266

On a Pure Coke..... 266

The Western Gas Association Meeting..... 266

Proceedings of the Fourth Annual Meeting of the Western Gas Association..... 267

The Construction of a Concrete Gasholder Tank..... 272

Otto v. Linford—*Re* the Gas Engine..... 274

A New Safety Lamp..... 276

The Deepest Coal Pit in Britain..... 276

Electric Lights that Went Out..... 276

Oil and Vapor Stoves..... 276

[OFFICIAL NOTICE.]

American Gas Light Association.

OFFICE AMERICAN GAS LIGHT ASSOCIATION,
142 CHAMBERS STREET, NEW YORK.

To the Members of the Association:

The Ninth Annual Meeting of the American Gas Light Association will be held in Boston, on Wednesday, Oct. 19th, and continue for three days.

Members of the Association are earnestly requested to prepare papers upon the many topics of general interest, to be read at that meeting. The Secretary counts upon the active co-operation of the members in his efforts to render the meeting of marked value.

WM. HENRY WHITE,
Secretary.

THE CONSTRUCTION AND RECONSTRUCTION OF GAS WORKS.

It goes without saying that the present is the time for intelligence, energy and care in the construction or reconstruction of all the plant used in the manufacture, distribution and consumption of illuminating gas. The day has gone by for carelessness, or for sitting down satisfied to do this year simply as well as was done last. Management and engineering that was good enough ten years ago, when gas companies could charge such prices, irrespective of the quality of the gas, as would bring in enough to cover the expense of wasteful working, and pay a dividend on, in some cases, an extravagant capital, will not do in these days of progress when the demands of the public are so loud and determined for better, cheaper and more abundant light.

The proper location of a gas works, especially as regards the coal storage and the retort house, has always been considered of primary importance, and is perhaps more to be sought for now than ever, when labor is so expensive and uncertain. The question of handling the coal, its residuals, and, indeed, all the heavy materials used on the works, at the lowest possible cost for interest on plant and for labor, is well worthy of the most careful consideration. In this connection we call the attention of our readers to the information contained in the article of Mr. V. Wyatt, constructing engineer to The Gas Light and Coke Company, London, written for the *Journal of Gas Lighting*. There are many works where the cost of taking the coal from the sheds and delivering it in the retort houses is greater than it should be, and where a large return could be made upon the capital required to reconstruct this portion of the plant.

In handling the coal, charging and drawing it, the tried improvements of Messrs. Ross, West, Warner, and others, have demonstrated the feasibility of very largely reducing the cost for labor. We think we are warranted in the opinion that no retort house, for a medium or large sized works, should now be designed or erected, unless adapted to some form of mechanical stoking. Then, in handling the coke when discharged, how often is it handled thrice when once would suffice?

There have been many and diversified opinions, in the past, among engineers as to the setting best adapted for carbonizing the coal. All sizes and forms of retorts and settings have been designed and used—some have used them for one reason and some for another. But it is accepted to-day that the setting of ten years ago is extravagant in labor, fuel, and the wear and tear of the materials of construction, not only so, but the necessary variation in the heats makes it impossible to obtain the best results from the coal carbonized.

The economies obtained by the use of the gas generator furnaces, and the settings heated thereby, have been so clearly and thoroughly demonstrated that the only question of the day can be which, of their many kinds, presents the greatest advantages. Every manager should give this question the earnest attention that its importance merits. It is not enough to say, "Well, there is an economy in all the items stated above; but we can't do anything with the surplus coke when we save it—can't get rid of what we make now." Save it any way, as a matter of principle, and, moreover, coke is our most valuable residual; it is valuable as a fuel—a pound of good coke is worth a pound of good coal, and, for some purposes, more. Educate the consumers in its use, if necessary; what has been done in Paris can be done here, there the gas company, in its annual report this year, states the

number of appliances sold for heating by coke, up to date, to be 52,183, nearly the whole of which are in use. The result is shown in the reduction of the cost of their coal by the sum of $3,271,000, or about 80 per cent. of the cost of the coal.

In considering the treatment of the gas as it issues from the retort, attention must be given that all of the permanent hydrocarbon vapors may be retained, the proper place for the light oils is in the gas not in the tar well. It has been quite satisfactorily determined in some of our works that the immediate removal of the heavy tars where the gas is hot, the hotter the better, gives a decided gain in the permanent illuminating quality of the gas produced.

Then the subsequent condensation and purification must be so conducted that not only is the quality of the gas considered, but also the quality and quantity of the residuals.

We have dwelt at some length upon the saving of coke, thinking it to be of great importance, and we would consider, if space permitted, the question of saving or utilizing the other residuals. Knowing what is done elsewhere, we believe that here, with proper management, with the adoption and improvement of plant, and by the cultivation of markets, and the education of the user, the cost of coal can be so largely reduced as not to appear as a serious item in the expense of gas making.

It is impossible, in an article like this, to even suggest the improvements that are making, and are to be made, in an industry so great as ours; we have merely indicated a few of them, yet the possibilities and probabilities of development begin with the coals at the wharf and only end at the burner. In this broad field there is room for even the humblest worker to improve and develop on his past experience, and we would that, when this year's heavy work begins, every manager might say, I am making and distributing gas more scientifically, better and cheaper than ever before.

PARTIAL DARKNESS IN NEW YORK.

As noted elsewhere, the electric lights, which partially illuminate Broadway from 14th to 34th streets, went out suddenly, with no premonition, on the night of Tuesday, June 7th.

Had it not been for the light obtained from the gas burning in the shop windows, the extinguishment of these lights, at the time of the extreme darkness and rain, would have caused serious inconvenience to all who were on that busy and crowded thoroughfare. As it was, however, the gas, which has a peculiarity of always being ready and good-natured enough to help the electric light out of its difficulties and mishaps, was on hand ready for work, and maintained its reputation for reliability and cheerfulness.

A short time since, in London, all the Brush electric lights, extending from Blackfriars to the middle of Cheapside, went out on a rainy night, and darkness reigned supreme until the gas lamps could be lighted; and for several nights the electric lights were out and the gas lamps had to be relighted. This record for unreliability we have seen exemplified by every system of electric lighting prominently before the public. We have seen about all of the arc systems under many and varied conditions, and we have seen them flash and die out, we have frequently seen the Jablochkoff lights in Paris chameleonize and go out, we have seen the carbon filaments of the incandescent lamps either burst or burn out, and we have heard of several instances where every incandescent lamp on the circuit has been destroyed in an instant by a too strong current of electricity.

We do not object to experiments in electric lighting any more than we object to experiments in gas lighting; but we think that all experiments, especially if risky or expensive, should be made at the cost and risk of the experimenter, and that he should not bring inconvenience, danger and expense on the public.

It may gratify some of our learned and progressive city officials to raise and expend so much for experiments in electric lighting; but we much doubt whether the average taxpayer cares to pay so much for so little, and be left in the dark the very time he ought to have light.

Facts show that all systems of electric lighting are still in the experimental stage; whether any one of them will ever issue from it, and take its place as a reliable and practicable method of lighting, is a question for the future.

The Petroleum Outlook.

SUMMARY.

The daily average production of crude petroleum for the month of April we find to be 73,526 barrels, with an increase of stock of 857,382 barrels; making total stock held in region of production 22,963,171 barrels, 20,785,744 barrels of which is in the custody of the pipe lines, 572,440 barrels held in private iron tanks not connected with the pipe lines, and 1,604,987 bbls. in wood tanks at the wells.

The number of producing wells at the close of the month was 15,769, with a daily average production of four and six-tenths barrels per well. The number of new wells completed and added to the producing wells was 316—after deducting 12 dry holes among the new wells, and 33 old wells which were abandoned during the month, makes the net increase of producing wells 269.

The number of drilling wells at the close of the month was 446, with 443 rigs erected and being erected, making a total of 889 wells in progress of development.

We have withheld the issue of this report until this late date for the purpose of receiving the well stock report from the producers' committee, which is just received, and shows a decrease for the month in the wood tanks at the wells of 19 barrels per well. Also, a daily decrease in stock held in private iron tanks at the wells of 757 barrels, amounting to 23,710 barrels for the month, to which add decrease in wood tanks of 184,300 barrels, making the total decrease in field oil, or oil at the wells, 208,010 barrels during the month under consideration.

THE OUTLOOK.

The outlook for better prices or a radical change in production in the near future is not very flattering. While it is quite evident that in the Bradford field proper, (especially in the older portions of it) the production is running down, it is just as apparent that the producing area is being extended in Warren and Forrest counties in Pennsylvania, and Allegheny county in New York, which bids fair to make good the amount that Bradford may lose and keep the production up to its present limit.

The developments in the Wellsville region especially bid fair to become a very important producing section. The Duke and Norton well is now producing about 50 barrels per day; the McBride well about 25 barrels; the Richfield well about 35 barrels, and some 10 other wells in the region are producing from 10 to 14 barrels apiece per day. The trade is now looking with great interest to these developments and generally regard them as shadowing forth large production and extensive producing territory.

With a daily average production of over 73,000 barrels, and a fair prospect of its being kept up for some time to come; and with a surplus stock of 20,000,000 barrels now on hand, it is evident that in order to realize permanently better prices, the demand from abroad will have to be increased during the remainder of the year.

We still look with confidence for a greatly increased demand for the export trade, as the stocks in Europe are very low as compared with the same time in 1879 and 1880, and are considered to be much understocked at the present time.—*Stowell's Petroleum Reporter*, May 21.

On a Pure Coke.

By W W. Staveley.

I have recently had occasion to test a sample of coke, made from coal tar pitch, which I found to contain a very small percentage of sulphur. Since it is not generally known that coke of such purity is obtainable in such large quantities, it may be well to record the analysis—

Sulphur	0.12	0.11
Ash	2.43	2.50
Carbon	97.45	97.39 by difference.

The sulphur was estimated by the prolonged boiling of the powdered coke, 5 to 6 grms., with nitric acid and a little chlorate of potash. The ash was estimated by heating for several hours in a Fletcher's muffle furnace at a white heat. The sample of coke was taken from the ovens and powdered whilst hot, thus ensuring the absence of moisture. Several determinations of sulphur and ash were made with similar results. A noticeable feature of this coke is that on exposure to the weather, even for months, it does not "slack" or disintegrate. This is no doubt due to the small percentage of sulphur present, the cause of the slacking of most cokes—gas coke especially—being attributable to the oxidation of the sulphides of iron contained in the coke. The heating and burden carrying power of this coke in the furnace far exceeds that of the best Durham coke. From its hardness and close texture it is especially calculated to resist the action of the hot gases on the upper portion of the furnace, thus diminishing the loss.—*Chem. News.*

The Western Gas Association Meeting.

On page 267 of this issue we begin the publication of the Official Report of the Proceedings of the Fourth Annual Meeting of the Western Gas Association.

The proceedings are replete with matters of interest and importance to every gas manager in the country. The sessions of the Association would have been much more largely attended were it not for the fact that damages caused by the spring floods in the West and North-west prevented a great many superintendents and engineers from being present who would otherwise have been on hand.

[Official Report.]

Proceedings of the Fourth Annual Meeting of the Western Gas Association.

Held at St. Louis, Mo., May 11, 12, and 13, 1881.

St. Louis, Mo., May 11, 1881.

The Fourth Annual Meeting of the Western Gas Association was held this day at the Laclede Hotel, St. Louis, Mo. The Convention met at ten o'clock, the President, Thomas Butterworth, in the chair.

Mr. Howard (Dubuque, Iowa) made a motion that all persons interested in gas matters be invited to be present during the sessions of the Convention, which was carried unanimously.

The President appointed as a Committee on Application for Memberships the following gentlemen:

Mr. Littleton, Quincy, Ill.; Mr. Lansden, St. Louis, Mo.; Mr. Howard, Dubuque, Iowa; Mr. Cosgrove, Chicago, Ill.; and Mr. Bates, Evansville, Ind.

President's Address.

The President addressed the Convention as follows:

Gentlemen of the Convention:—In accordance with the rules of our Association, it becomes my duty to present to you my views in the form of an address, and if you will give me your attention I will try to perform that duty.

In meeting with you at this, the fourth annual assembly of our youthful Society, it affords me no small amount of pleasure and gratification to see you one and all, take such an interest in our meetings.

Our increase in number of members has been very flattering; and when we consider that many of us have to travel hundreds of miles to be present, at great personal sacrifice in some cases, it is abundant proof that the parties who suggested and organized our Western Gas Association only supplied a long-felt want.

The past year has been one of the most successful on record as to our special branch of manufacturing business. If we take into consideration the great amount of competition—coal oil almost given away, electric light at less than cost—the increased sale of gas is truly wonderful, and to my mind is a convincing proof that in the future, as in the past, money invested in our business will be sure of a fair return in the shape of dividends, provided we, as gas managers, act like prudent business men; and I think this meeting will agree with me in the assertion that a gas manager, or someone connected with him, in addition to knowing how to make a good article of gas economically, must possess more than an average amount of business tact, and be able to use it at a moment's notice when called upon, in the thousand and one problems that are daily brought before gas managers for solution.

I can call to mind several instances in our own and adjoining States where the want of a little good business tact on the part of persons in charge of the management of gas works has led to the substitution of coal oil or electricity for street lights where gas had been used for years. In one city of 13,000 inhabitants, on the expiration of the street lamp contract, the city council offered within 7 per cent. of what the gas company had bid to light the street lamps in a new contract; but so stubborn and unyielding were the gas people, that no offer of compromise was made or conciliation attempted, but instead street lamps were threatened to be shut off. Then the city ordered coal oil and electrical machines as if such things cost nothing, and will spend money free as water "to teach the gas men a lesson," as they put it. This is not an isolated case by any means. It is only one of many where the lack of a little common business sense has culminated in serious loss, not only to the gas company directly concerned, but to the entire gas interest.

Again, in some towns it seems to me as if the parties in charge of street lighting try how little and not how much light can be got out of gas burned in street lamps. What is really a good candle power gas is cut down 25 or 50 per cent. of its light-giving qualities by unsuitable burners and dirty lanterns. It may be that the gas manager cannot help such things, not having the control of lamp lighters or lighting; but he can offer a great many suggestions to the party who has control, and if it took all summer and all next winter I would keep offering suggestions until things suited me.

In all cases where it can be done, I am convinced that gas companies ought to have full control over street lighting, even to the actual ownership of lamp posts and all. Then, with a very little attention to furnishing the kind of burners suitable to the quality of gas supplied, having the lanterns regularly cleaned and in good repair—these things will go a great way toward giving satisfaction to both city council and the citizens in general, who will in the end, notwithstanding so much has been said to the contrary, be willing to pay a fair price for a good street light that is always on hand when wanted.

In cooking and heating by gas there seems to be an unlimited field for extending our sales. What little effort I have made to introduce gas stoves has convinced me that in the near future 20 per cent. of my total sales will be used for other than lighting purposes.

The manufacturers of gas stoves have shown a very commendable degree of enterprise and no small amount of skill in bringing to our notice stoves that will do the work they are intended to do, and in such a manner as to cause no offensive fumes or smells such as we find when cooking the same kind of food with any other fuel than coal gas.

With the use of gas for motive power I have had no experience, not having been able as yet to purchase gas engines for what I consider such engines ought to be made and sold. I have, and I suppose most of you have also, received a circular asking me to furnish gas for use in gas engines at a less price than for other purposes. I do not know how it looks to others, but to me (having sold gas for years, when our town was small, absolutely at cost, and for more years than one I had to earn money from outside sources to pay taxes and keep the concern going), it looked a little cheeky to be asked to reduce the price of gas to help sell gas engines at prices that must yield over 100 per cent. on the cost of manufacture.

Every gas manager is more or less compelled, from the very nature of the business, to buy and use special machinery, and has to pay the prices asked or go without the machine; while, on the other hand, what he has to sell has in most cases an arbitrary price fixed by legislation, irrespective of cost of material or wages paid to make gas; and in small towns he is compelled to educate the people in the use of gas as a necessity, not a luxury, before he can make sales large enough to establish his works as a paying concern.

Now, such being the case, I most earnestly and urgently ask of the manufacturers of machinery to be used for special purposes in and about the gas business, to do as all good gas managers do—put down the price of your machines as low as you possibly can, consistent with making a first-class machine, and depend upon increased sales to make up your profit. Do this, and your patents will not run out untried, unused, and unsold.

With reference to the circular of subjects for discussion at this meeting, which our Secretary mailed to all our members and friends interested with us,—I hope to have a full and free discussion, that each and every one will add his mite. Tell what you are doing and have been doing in the past year. No matter if you have failed to attain the amount of success that you expected, for we all know that our failures add to our knowledge fully as much as our successes do. Gas men, above all others, have to follow the Apostolic command to "try all things and hold fast to that which is good." So, friends, tell us of your failures, just as Mr. Nettleton told the New England Association, at its last meeting, of his want of success with his gas generator furnace.

Some 25 or 30 years ago, when iron retorts were in use, we used to build our furnaces very low down in the bench and make very narrow slits or openings, only just one grate bar, splaying the furnace out to 15 inches wide at 2 feet above the grate bar, taking great pains to have tight brickwork, to keep out cold air, as it cut the iron retort, so to speak, wherever it impinged on it. On one occasion our engineer gave instructions to run flues back and forward under the bed, through which to pass in cold air that would accumulate heat in its travels. These flues had their exit just over the fire surface and under the bed shield tile of the bottom retort on each side of the furnace. In 90 days we had no retorts or bed tile left—only one mass of melted lava; had to dig it out with chisel and sledge.

I have now, up and ready for next fall, a bench of five fire clays set as nearly as possible on the above-named plan, the working of which I hope to be able to lay before you at some future meeting.

During the two years last past we have had brought to our notice again and again the great saving in fuel and the better yield of better gas produced by using some of the various kinds of gas fuel-producing or so-called generator furnaces. My own experience would lead me to doubt their being an improvement in small works, and for large works we have the statement of the Paris (France) Gas Commission, after 18 years experimenting and trials, that money expended in making the change from common to generating furnaces will not pay 6 per cent. interest. It is for parties interested to say how much we in the West can afford to pay for experiments not yielding 6 per cent. on the Continent of Europe. There may be places where a cheap coal can be had for converting into gas fuel (so as to sell all coke made), where regenerator furnaces can be used to advantage.

While on this subject allow me to point out to you the wide difference that sometimes exists between statements made by the correspondents in our technical papers, when writing up their furnaces, and the balance sheets submitted to the stockholders in companies using such furnaces. Some time ago a correspondent in the London *Journal of Gas Lighting*, in speaking of a generator, made the statement that after years of experimenting and adapting some of the best features of Continental, European, and

American furnaces, a furnace had been produced that only used 12 per cent. of the coke made; whereas the common, ordinary furnace of the same size and capacity used fully 20 per cent. of all the coke made. The writer then very modestly states that these results are not always secured, but on an average the saving of fuel by these generator furnaces spoken of may be taken as fully 25 per cent. of the old consumption.

A little while after, in the same London journal, was published the balance sheet of this company using both the old style of furnace, said to be consuming only 20 per cent. of the coke made, and the new style of generator, using only 12 per cent. of the coke made; yet the balance sheet shows that 27 per cent. of all the coke made is used in furnaces of this company, of whom it is said that "nothing succeeds like success." When one of the stockholders asked about this using so much coke, the managing engineer made the statement that 27 per cent. was not, in his opinion, an excessive amount as things now go, and at the same time he expresses a kind of doubt of other companies being able to get along with only 20 per cent. of the coke made.

With such statements as these before us, I ask you, friends, ought we not, as careful business men, to give a great deal of thought to this subject before we recommend our directors to expend money in making doubtful changes?

In saying what I have, I hope the gentlemen who do not know me will not set me down as an old fogy, afraid to move out of a given line; for I can truthfully say that I have tried more new things than I ought to have done. And should this Association, or any part of it, enter into an arrangement to fill out blanks to be agreed upon, of actual results, (and I sincerely hope and recommend that such a course be adopted for our own information, not for publication outside of actual contributors), in such event I shall contribute my share of statistics, be they good or bad, and willingly submit to be placed in the class that results justify.

With reference to the treatment of gas after leaving the retort, I feel satisfied that we have much to learn, and there are many mooted questions to settle.

Some gas works are so situated as to be using a coal that makes it incumbent on the manager to get all the yield of gas possible, paying no attention, or very little, as to amount of tar or other residuals.

Again, other works may be compelled to use a coal chock full of ammonia, carbonic acid, and what we call other impurities. In the last case the manager must not run his gas production too close. The last few feet to distill over may render his whole make unmerchantable, so to speak. But by governing his yield to the known capacity of his purifying plant, though getting from 1,000 to 1,500 feet less per ton than his neighbor, with better coal, yet by attending to what has heretofore been considered bye-products—and waste at that, so far as our section of the country is concerned—he may be able at the end of the year to show a more favorable balance sheet. So far as tar and ammoniacal liquor are produced, they may now be said to be fixed factors of income if properly handled. But there is one production that it seems to me ought to be handled more to our benefit than has yet been done. I refer to carbonic acid. Some of our coals contain such quantities of it as to greatly reduce the illuminating power of the gas. But instead of costing us money to get rid of it, carbonic acid ought to, and I feel certain soon will, be handed over to the soda manufacturer in such a shape that he can afford to pay for it.

There is a large money value to be realized by the gas manager who shall devise a way for eliminating from crude coal gas the last vestige of ammonia, sulphuretted hydrogen, and carbonic acid, in closed vessels, by adding thereto such compounds as may be needed to fix them in proper shape for the chemical manfacturer to obtain the 80 to 100 pounds of soda-ash that every ton of coal is said by chemical experts to contain. This is one of the problems that must be solved, and that, too, in the near future; and we as gas managers ought to do it. By so doing we can reduce the price of gas, and at the same time add to our ability to pay fair dividends.

There are some other things I ought to call your attention to, but will not, for fear of taking up too much time, and knowing that there are others better able to occupy it. Thanking you for your kind attention, we will now take up the regular order of business.

On motion, the address of the President was referred to a committee of three, composed of Messrs. Lansden, Averill, and Somerville, with instructions to report thereon.

REPORT OF COMMITTEE ON APPLICATIONS FOR MEMBERSHIP.

Mr. Littleton, Chairman of the Committee on Applications for Membership, reported the following names for membership:

John M. Kennedy, Rockford, Ill.; C. E. Grey, St. Louis, Mo.; W. B. Mills, Montgomery, Ala.; Frank Beck, Galveston, Texas; E. W. Baily, Fort Worth, Texas; J. W. Coppinger, Alton, Ill.; and C. M. Keller, Columbus, Ind.

For special membership, A. T. Prentiss, Chicago, Ill.

On motion, the Secretary cast the ballot of the Association, and the above-named gentlemen were enrolled as members thereof.

The President introduced to the Convention Mr. Price, of Cleveland, one of the visiting members, and called upon him to address the Convention.

REMARKS OF MR. PRICE, OF CLEVELAND.

Mr. Price made the following remarks:

Mr. President and Gentlemen of the Convention:—I came here merely as a looker on, not to take part in the proceedings of the Convention. I did not come here to teach, but to learn. I am here almost incidentally, having just come from another point, and I hardly know what I can say that would be of interest to you.

The air is full of all sorts of things about which people are inclined to think and talk. Gas men are attacked by enemies on the right and on the left. Like Tennyson's "Charge of the Light Brigade," there are enemies to the right of them, enemies to the left of them, and enemies in front of them; and it is very natural that men engaged in the same industry, when their interests are at stake, should come together and fraternize, harmonize, and solidify themselves, and get from each other all that they can in the way of improvement.

I think the gas interest at this time is going through a sort of crucial test. I am not one of those who believe that the gas interests are ruined because another competitor is coming into the field. As your Secretary suggested to me yesterday, I am inclined to think that the gas interest is only in its infancy, and that we are just about to enter upon a field which gas men have hitherto neglected—that is, the supply of gas for the running of machinery, which is going to be a very important element in our business. Where I live there is almost a boom in favor of the cooking stove, and I think we will sell hundreds of them this year. The use of the cooking stove will help our consumption. Before long we shall have gas engines. We have been very slow to introduce them into Cleveland, but I believe the prospect now is very good for their adoption there.

I suppose you all know that in Cleveland we have a good deal to contend with. We have several electric light companies. There are companies organized for the purpose of introducing the Brush electric light, the Maxim electric light, the Edison electric light, and we have the greatest oil company and manufactory in the world; and I regard oil as one of our greatest competitors. To live in Cleveland is to live in the very focal point of these antagonisms; but thus far we have been able to hold our heads above water; in fact, our consumption is increasing every day. During last month we manufactured more than we did the corresponding month of last year. This is only an isolated fact, and may not indicate much; but these things are growing steadily. There is no doubt that we shall lose some of our consumption through the electric light, but I am inclined to think that we shall gain in other directions.

I do not intend to take up your time in saying anything else. These few remarks are entirely off-hand and unstudied. I am glad to meet you, and hope you will have an interesting and profitable meeting.

Mr. Goodwin, of Philadelphia, a visiting member, was called upon by the President to address the convention, but he stated that he would prefer to postpone anything he had to say until to-morrow, when he desired to lay before the Convention some interesting matters.

REMARKS OF MR. MUNZINGER.

Mr. Munzinger, of Philadelphia, was next called upon by the President to address the Convention, and he came forward and spoke as follows:

Mr. President and Gentlemen of the Convention:—I am not prepared to make any particular remarks at this time, as I expect to address the Convention, with its permission, before it adjourns, in regard to the quality of gas, in regard to light, in regard to the units of heat, and some other matters of that sort. I have been at various places where they have been using the light, as it is claimed in opposition to gas. I have been myself since 1854, I may say, engaged in experiments in regard to the electric light. I have investigated the subject somewhat recently, and have come to the conclusion that the electric light costs three times as much as gas. For instance, to produce the electric light in New Jersey, where I examined into the matter, for 22 lamps it takes 3,000 pounds of coal, worth about $6 a ton; the oil costs 50 cents; the water costs about 75 cents a night; there are 5 men employed to run the machinery and adjust the carbons, at $2 a day, making $10; the carbons cost 18 cents a-piece, there being 35 of them; and there is required a 35-horse power engine. This, compared with the cost of a volume of gas sufficient to produce the same light, would be in the ratio of 3 to 1.

In regard to light and heat. Musical notes to the ear are what colors are to the eye. When there are 40,000 vibrations of sound per second, the ear is no longer conscious of them. So it is with light. When the vibrations of light are 800 billions per second, the eye is no longer conscious of them; they pass through the pupil so quickly that the retina is unable to take

cognizance of them. Candles, oil lamps, and gas give our mellow, soft light; then we have the calcium light, the magnesium light, and then comes the electric light. These latter lights are so intense that they dazzle the eye, and this was proven by the fact that a young man had to quit working in an office in New York City where the electric light was used, because it injured his eye-sight. In sound the vibrations below 16,000 per second represent a hum; those above 40,000 per second are like the crack of a whip, the explosion of a cannon, or the shriek of a wild animal. All light vibrations below 450 billions per second are made sensible to us by the touch; those above 800 billions per second are made sensible to us by a chemical compensation. So you see that sound is to the ear what colors are to the eye. Four hundred and fifty billions of ether vibrations represent a red color; 800 billions represent a deep violet color.

As for the electric light, they have been at it for thirty years; it is an old thing.

In regard to gas engines. When we are running a boiler by coal or coke, we have to measure by units of heat. In all measurements of heat we have a certain unit of heat, which is represented by 772 foot-pounds per minute; in other words, to raise the temperature of water from 59° to 60°. According to this, coal is represented by 13,006; petroleum by 20,240; coke by 10,970; wood by 6,582; while a pound of gas is represented by 24,000. Where you have a gas engine made by Otto, you create an explosion by mixing gas and air in the proportion of 1 of gas to 6½ of air. Where you put 1 foot of gas to 15 cubic feet of air, you have a light explosion; but where you have 1 to 6½ the explosion is more severe. This compound is admitted behind the piston into the cylinder and exploded. The piston is moved against the atmospheric air and then driven back into a vacuum formed by the collapse of this gaseous mixture. It takes a force of 7 pounds to drive the piston home. Taking, for the consumption of a cubic foot of gas per minute, the heat supplied to be 756, and multiplying that by 772 foot-pounds, we have 82,500 foot-pounds yielded at the brakes; divide that by 33,000 pounds, and you get the horse power, which would be about 2½. Take the explosions made (probably there are 30 in a minute), multiply the gas that is consumed, 1.05 cubic feet, by 60, and you get 6,300, which, divided by the 2½-horse power, gives about 25 feet of gas per hour. If gas engines can be supplied at the cost of ordinary engines, I think they can be introduced very readily. I think we ought to do as some gas makers have done—reduce the price of gas, and then gas engines will soon come into general use.

On motion of Mr. Cosgrove (Chicago), the members of the American Gas Light Association who are not members of the Western Gas Association were invited to take part in the discussions of the Convention.

ELECTRIC LIGHT.

Mr. Brown (Evanston, Ill.) read the following article on the electric light from the Chicago *Evening Journal:*

"*Edison's Electric Light.—An Expert Electrician Examines the New Illuminator and its Modus Operandi, and Pronounces it Successful.—Letter from Professor Carhart, of the Northwestern University.*

"NEW YORK, May 5.—Through the courtesy of Mr. F. W. Jones, general circuit manager of the Western Union Telegraph Company and president of the New York Electrical Society, your correspondent was favored last evening with admission to Mr. Edison's private office at the headquarters of the Edison Electric Light Company, on Fifth avenue. The purposes of this company are sufficiently well known. It has now a local habitation in an elegant Fifth avenue mansion, brilliantly illuminated every evening as an announcement of Edison's apparent success in domestic lighting by electricity.

"As we were about sending up our cards Mr. Edison entered the vestibule and conducted us directly to his office. The room was dark when we entered, but a quarter turn of a hard rubber key almost instantly filled it with mid-day brightness. There was no adjustment of the key, no flickering of a gas flame, no disagreeable and deleterious products of combustion, but the steady glow of a lamp of 16-candle power. This particular lamp depended from a curved brass tube attached to the top of a large double cylinder desk. Over the pear-shaped bulb was suspended a white glass shade, which reflected the light down upon the accumulated business papers on the desk. In the upper hall an uncovered lamp was attached to an ordinary gas bracket, while a chandelier of four electric lights surmounted the newel post in the main hall below.

"Mr. Edison received us cordially, made no reference to gas illumination, but discussed the "ultra-gaseous state of matter," which was my topic for experimentation in Cooper Union the following evening, and then kindly cleared up several points in the construction and practical working of his lamps, about which I had been in doubt. These lamps are now exhausted to about a millionth of an atmosphere, so that the consumption of the carbon conductor by combustion may be entirely disregarded. These latest lamps are constructed of a carbonized fiber of bamboo. A piece six inches long, cut between joints, is pared up into thin slices; then the slices are further cut into very narrow strips, no thicker than a fine knitting needle, and these have their ends prepared to enter suitable clamps for connection through the glass bulbs with the electric circuit. About 1,500 of the bamboo fibres are bent around a form in the shape of a slender letter U, are inclosed in a practically air-tight mould, and carbonized in a very hot furnace. The factory at Menlo Park has now a capacity of 1,500 lamps per day. Each lamp has a resistance of 125 ohms for 16-candle power, and its "life," or duration, is about 300 hours. Any device that will lengthen the life of this carbon fiber will, of course, make the system more economical. But that it is merely a question of economy, affecting the practicability of the lamp in no other way, is evident from the fact that a used-up lamp can be replaced much more quickly and safely than a broken lamp chimney. Three or four turns of the glass bulb remove it, and as many more in the opposite direction, of course, replace it again.

"This Edison demonstrated to us by extinguishing a lamp and immediately removing it. It was replaced in from 3 to 5 seconds, and the turning of the key was alone necessary to relight it in as great perfection as before. There was no hot glass to handle, no plumber was required, no connections were to be made gas-tight, and no match dropped its charred end to soil the carpet.

"The plan is to have a boy deliver daily these glass bulbs wherever they are needed, a small supply being kept on hand at every house. Then whenever a lamp fails it can be replaced at any moment.

"The tariff for each consumer will depend only on the electricity used, and not upon the number of lamps that may be required. Hence it will be an inducement to the company to make the lamps as durable as possible. This removes the most serious objection to Edison's system that presents itself to an outsider. If, with this commercial drawback, the system can still be financially successful as compared with illumination by gas, then the incandescent electric light is the light of the future, at least for domestic purposes.

"Mr. Edison explained the giving way of the carbonized fiber in a way that was entirely new to me. Consumption by oxidation has nothing to do with it, but the carbon is volatilized and slowly transported across from the negative pole to the positive. Every lamp gives way at the negative pole; and no fiber fails at any imperfect point, where there is a nick made, for instance, unless that point is near the negative pole. If it is at the positive, the fiber is in no way endangered by it.

"The Edison lamp in its present form represents the product of a vast outlay of inventive energy as well as hard cash. Difficulty after difficulty has been met and overcome. Mr. Edison has called to his aid not only skillful mechanics, but expert electricians, calculators and financiers. He has now forty or fifty glass-blowers who have been taught in his own shop, every one of whom can make a lamp from beginning to end, so far as the work in glass is concerned. Every point, from the dynamo-machine up to the lamp, has been experimentally tested with the object of making a commercial success. The relation of parts, that is satisfactory with only a scientific experiment in view, is found not to hold when machines and engines and conductors are increased in size up to the requirements of a vast commercial undertaking. Hence the financial outlay and the months of delay before the present stage has been reached. Now that the Board of Aldermen have voted the privilege of laying conductors, notwithstanding the Mayor's veto, the work of establishing machines at central stations and of laying conductors will be pushed forward with vigor. The conductors, consisting of copper rods of semi-circular section, with the flat sides turned toward each other, will be placed in gas pipes, and the whole intervening space between the conductors and the pipe will be filled with insulating material. Each lamp will be placed in an independent circuit running from one of the main copper rods across to the other. The system may be likened to a ladder, the sides of which correspond to main conductors, connected at one end with the dynamo-machine, while the rounds answer to the cross circuits in which the lamps are placed. This is called connecting them in multiple arc; and since there are to be many lamps in the circuit of each dynamo-machine, and the incandescence of each carbon is due to its resistance to the passage of electricity, it is evident that the resistance of the carbon must be made high. The larger the number of lamps in each circuit in multiple arc, the larger must be the resistance of each lamp; for the larger the number of these cross-wires containing the lamps, the larger the number of paths for the electricity from one conductor over the other, and the smaller the total resistance of the circuit; and unless the resistance of each lamp is made high, the combined resistance of many lamps in *multiple arc* would be reduced to a quantity comparable with the resistance of the large conductors and the machines. In that case a considerable portion of the energy of the current would be lost in traversing the large conductors, as the heat produced in each part of a circuit, considered as a whole, varies according to its proportion of the resistance. Unless the current is employed to do mechanical work by means of electro-magnets

it is all converted into heat in going round the circuit. The adjustment of resistances must, therefore, be such as to develop the largest possible proportion of the total heat-equivalent of the current just where it is wanted—that is, in the carbonized fiber of the lamps.

"Mr. Edison impresses a stranger favorably. His enthusiasm, affability, ready explanations and open-heartedness disarm criticism. I have evidence of his liberality in the unsolicited and unexpected order to his secretary to send half a dozen of his lamps to me, as the representative of the University at Evanston. His reputation has been injured because he has been working in the interest of a stock company, which has repeatedly sent to him reporters for the purpose of drawing him out in the interest of stock appreciation. These have poured into the public ear exaggerated accounts of his successes and great expectations. The inevitable delays incident to every such great undertaking have been accepted by the public as evidence of failure. Mr. Edison's reputation as an inventor has accordingly gone up and down with the price of electric light stock. A moderate consideration of the problem of electric lighting must convince every intelligent man that even superhuman genius might not solve it in a week or a month. The perfected electric light will be the product of the highest civilization of the age. Its dazzling brilliancy is the focal point toward which converge the light of many sciences and the luster of the noblest arts.

"H. S. Carhart."

Mr. Munzinger had read by the Secretary the following article from the Philadelphia *Press:*

THE ELECTRIC LIGHT.

"The Old and New Systems of Illumination Compared.—Edison and His Rivals.—How the New Light is being Introduced.

"Standing a few evenings since, looking at the electric lights burning in front of the Continental and Girard, and discussing the future of this great illuminating power, a tall, broad-shouldered young man, apparently not over thirty years of age, joined the reporter. 'This is Mr. C. L. Buckingham,' said the gentleman with whom he was conversing, 'the electric expert of the Western Union Telegraph Company. He used to be an examiner in the Patent Office and reported for patents nearly all the different electric lights which have attracted attention and became useful for illuminating purposes.'

"'What is the future of the electric light? Can it ever be controlled so as to be available for illuminating private residences and for other purposes where the light is to be regulated?' was asked.

"'That is a question yet to be settled. My opinion is that it may. It will take time, however, and careful manipulation to bring it to that point. Money and patience, I think, will accomplish it. The necessary talent is at work already on the problem.'

"'How many kinds of electric light are there?'

"'Only two, primarily. The broad principle of producing light by electricity is by no means new. It was patented thirty years ago in England. The present patents are not granted upon the broad claim of producing light by electricity, but of utilizing the light produced. The Brush and Edison lights represent the two different kinds. The first produces and regulates its light by passing the current of electricity through two carbon pencils, placed at equal distances from each other, and the sparks jumping from one to the other produce the light. These pencils are fed toward each other automatically by the current of electricity which passes through the carbon pencils. The flicker you sometimes see is caused by the uneven feeding of the pencils.'

"'How long will these pencils burn?'

"'Each pair of pencils will last from eight to eleven hours, but they have a second pair so arranged as to automatically drop into places after the first ones burn out, and thus keep the current up so that continuous light may be obtained for nearly, if not quite, 22 hours steadily.'

"'Are all electric lights based upon this principle?'

"'No, the Edison light is produced by passing currents of electricity over some substance having a high electric resistance. This may be the carbonized paper, wood, or fiber of some description. The operation of these currents of electricity upon these substances resisting the electric currents produces the incandescence. There is, however, what might be called a mongrel light; it, as a light, is perhaps the finest of all, but it is too expensive to be practicable. That is the Jablochkoff light. It is constructed by passing the two carbon pencils through two candles composed of vitriolized matter. The currents of electricity are passed through these into a horseshoe, and as the points of the carbon pencils burn away they heat this vitriolized matter to incandescence, and therefore a steady and powerful light results from the union of the two. It is the invention of a Russian.'

"'These three cover, I understand, the foundation principle of all the other kinds of electric light?'

"'Yes, sir, the first two really do. The other patents are simply as to the mechanism by which the light produced by these principles shall be controlled and utilized. Many electricians are experimenting upon the mechanism in the hope of being the one to reach and perfect such points as will make the light a practical success.'

"'Who is the most likely to succeed?'

"'The man who is backed by the most money. It not only takes time and talent but money to perfect such a great discovery as this. There are a thousand little points to be experimented upon and improved, all of which consume time and require means. The two men dealing with the electric light for general illuminating purposes are Edison and Maxim, who represents the United States Electric Light Company. He is backed by plenty of means, as we all know Edison is and deserves to be. I speak of these two men because they are the most prominent figures engaged in the work. There are, of course, others. Mr. Edison and Mr. Maxim while proceeding upon the same principle, diverge very seriously in some of their positions. Mr. Edison produces his light in a vacuum—that is, a glass globe with the air forced out. Maxim insists that the air will work in and injure Mr. Edison's light; he therefore fills his glass globes with gasoline. Other experts attack other points of Mr. Edison's mechanism and methods, and from out of all the experiments something practical will undoubtedly be obtained. My impression is that Mr. Edison's experience, position and backing give him the fairest chance of success of any man now searching for the vital principle of producing light to take the place of gas.'

"'I thought Edison's light was already a success?'

"'Experimentally it is. He can take you into a house or room and show you it lighted by his methods, but that does not settle the question of its practicability. Before it is a practical success it must be demonstrated that this light can be burned for an indefinite period without the danger of going out—and many, many other things which are yet only experimentally successful, and even that in a limited degree. You have no idea,'" he continued, "'how many important points are to be covered in making practical such a great invention as this. Why, the quadruplex telegraph, one of Mr. Edison's great inventions, has been many years in being perfected, and cost the Western Union Telegraph Company a vast amount of money. When it was purchased from him there were, perhaps, a hundred experts set to work upon the quadruplex telegraph, whose positions in the Company and whose promotion depended upon their success in manipulating it and remedying its defects. It has taken six years or more to perfect that instrument so that we can send four messages each way upon the same wire. Money, time and skill have perfected this invention. No doubt the same elements will make the electric light a success, but the public must not expect too much at once. Very much has already been accomplished.'

"'Has the economy of the electric light been fully established?'

"I should hardly think so. I do not, however, know from any personal knowledge. Of course, it is a much superior light to gas, but economy is a greater consideration even than effect.'

"'Is there any question as to its economy when perfected?"

"'I hardly think so, for the construction of dynamo electric machines is becoming more perfect, and the best ever invented, the modern Siemens, an English machine, is now common property, its patent privileges having lapsed in this country so that it can be had for the cost of construction.'

"'Are these dynamo-electric machines used for all kinds of electric work.'

"'They are being rapidly introduced for that purpose. The old system of batteries is fast giving way to these new machines. Without them the production of light by electricity would be out of the question. Batteries were too expensive and too uncertain to rely upon for such services. You may imagine the difference,' "continued Mr. Buckingham" "'between these machines and the old batteries when I tell you that in New York one entire floor of the great Western Union building was devoted to batteries with a capacity of 19,000 cells. We have recently put in a few dynamo-electric machines which occupy a space of less than twenty feet square and give the power of 150,000 cells. Besides, the currents produced by these machines are more steady and reliable than those given by the old batteries which were always apt to be weak and unsatisfactory in wet weather. The currents produced by the dynamo-machines are regular and unaffected by the weather. We are doing all our work with them in the New York office, and, besides being more satisfactory, they give us the same power, at one-quarter of the cost, of the old batteries, which were difficult to manage.'

"'Are four messages each way the most that can be sent over a single wire now.'

"'Yes, with anything like practical certainty. Gray claims to be able to send a greater number over his vibrating system, and this may eventually be successful. It consists in having a series of vibrators, which, when operated upon at one end of the line, respond upon the vibrators at the other end. If this can be made successful the capacity of a single wire may be largely increased over that now possible with the quadruplex.'"

Mr. Price—I desire to call the attention of the Convention to one point in the article of Professor Carhart, the Massachusetts electrician, and that

is the expression, "The Edison lamp in its present form represents the product of a vast outlay of inventive energy, as well as hard cash." All of you, perhaps, saw a statement, which I believe has not been denied, and which is perfectly authentic, that only a short time since the members of the Edison Electric Light Company of New York went before the Board of Assessment of New York and asked for a reduction of their assessment. They said that they were assessed too high; that, although their capital was nominally $1,500,000, there never had been but $350,000 subscribed; that only $40,000 was paid in; that they were in debt $45,000, and that they thought their assessment was excessive. And I think so, too.

The President—I recollect having my attention called to the article referred to by Mr. Price, and when I read it I told the party who showed it to me that it was an advertisement, and that somebody had got paid for it.

Mr. Brown—I think you are wrong, Mr. President, in regard to that. Professor Carhart is known by all the scientific men of this country; and I know that he is a man whom dollars cannot buy.

Mr. Munzinger—Mr. Edison and the men who are getting up the electric light do not know to-day what the electric light costs. They claim that a 1-horse power engine can be run on 2½ pounds of coal. I admit that, but you have to have an expert engineer, such as all our ocean steamers have, where they work under low pressure. They say they get a vacuum of 20 inches of mercury. So they do; but take all the engines of this town and their consumption, and you will find that it will come nearer to 10 pounds per horse power. That is my experience. I have taken charge of engines and have noticed the consumption of coal; and I have found that by the Corliss engine it takes about 5 to 6 pounds of coal to a horse power. If you take one of our old-fashioned engines it would probably use a little more coal, but they save in repairs. I was at the Centennial when Mr. ———, probably the greatest electrician in existence, was there, and we made some experiments in regard to horse power and measuring by the ohm—that is, resistance. We found that the Gramme machine took the least horse power, but to produce a light of 2,000 candles it required 1 horse power. I maintain, as I said before, that the cost of producing electric light as compared with gas light is 3 to 1. If you want to illuminate a space of, say, 1,800 feet in diameter, the electric light is superior to gas, and the same is true if you want to light a large hall; but if you want to illuminate a space of 1,800 feet in diameter the light would have to be at least 300 feet high. The light from electricity casts a heavy shadow, and for that reason it never will take the place of gas as an illuminator. As I said in regard to the vibrations of sound per second, lights are measured by the same standard. Light travels at the rate of 182,000 miles per second. From that we get our standard. That represents 5,400, while the electric light represents about 4,200; the calcium light, composed of oxygen and hydrogen, would probably be about 3,000; while gas would be about 1,800. Gas light is the yellow color, or what we represent on the thermometrical scale by 1,800 temperature. When they get to the point where they can make electric light for less than gas can be made, then I am going to change from gas engineering to electric engineering.

The Convention at this point took a recess till two o'clock.

AFTERNOON SESSION—May 11.

The Convention reassembled at two o'clock, the President in the chair.

Mr. Lansden, Chairman of the committee appointed by the President when the Convention was not in session, to fix the next place of meeting of the Convention, reported that they had selected the city of Chicago. The report was adopted.

ADDITIONAL APPLICATIONS FOR MEMBERSHIP.

Mr. Littleton, Chairman of Committee on Applications for Membership, reported the names of the following gentlemen, who were unanimously admitted to membership in the Association:

H. E. Clark, Kansas City, Mo.; James Montgomery, Sedalia, Mo.; W. H. Judge, Rock Island, Ill.; Charles Were, Marshalltown, Iowa. And for honorary membership, E. T. Howard, St. Louis, Mo.

COAL TAR.

The President laid before the Convention a letter from Mr. Geo. Shepard Page, the coal tar manufacturer.

On motion, the letter of Mr. Page was filed, and the thanks of the Association tendered to him for his communication.

The President stated that the subject of coal tar was open for discussion.

Mr. Brown—It may not be generally known that there are over 10,000 separate and distinct products from coal tar.

Mr. Smith (Grand Rapids)—In 1851 President Miller, of Glasgow, made some coal tar dyes for the exposition in London, which he no sooner presented than he was offered £1,000 for them. He was the means not only of showing to the people of London what could be done with coal tar, but of organizing different chemical works around the country. He began in Glasgow on a small scale, with two or three young men; and I saw lately that he has 400 men now working in his chemical laboratory. He has put up a chimney 400 feet high and 40 feet in diameter, and he produces all these chemicals there. Since I have come to this country from Scotland I have taken some very beautiful dyes out of my coal tar, but on so small a scale that it did not pay. I would say to the members of this Convention that they can make use of all their coal tar. Some of the dyes produced by Professor Miller were sold for $300 a pound, but after they began to find out how he did it the price was reduced to $12 a pound.

Mr. Lansden—The coal tar company that takes the coal tar from our works in St. Louis have made arrangements to commence preparing railroad ties with creosote. They have made tests which have proven satisfactory, and they are going to erect works immediately.

The President—With reference to coal tar, I will state that I have never been able to get beyond the first stage of burning it for fuel; but I have been very successful at that. I use up every gallon in the furnaces. I would like to see such works established as Mr. Lansden refers to, for I know there is a large amount of money to be made in working up this bye-product. I recollect when I let it run into the river; but now I am burning it, and it is worth about 7 cents a barrel for fuel.

Mr. Price—We have had for several years in Cleveland a distillery for working up coal tar to a limited extent. They attempted at one time to make anthracene—and did make it, and sent it to London; and I believe the first shipments were profitable, but for some reason or other after that it did not sell; it could not compete with the English article. They also manufacture carbolic acid. Of course, their main object is to get the grosser forms; they are not aiming to get at the finer qualities in this article. It is something marvellous, the wonderful things that are contained in this coarse, sticky, disagreeable article, which some years ago was looked upon as perfectly worthless, and even as a nuisance. When I was in London two years ago, I went down to the works of the London Gas Light Company, and was very politely shown through the works. They took me to the chemical works, where they were making anthracine, which they said was then worth $800 a ton. They were also making sulphate of ammonia. They did not seem, however, to be carrying the manufacture of the products of coal tar to the extent that the Germans and French seem to be doing. Captain Mason, of our town, in his last report to the State Department, from Switzerland, where he has been Consul, gave some interesting facts in regard to the manufacture of aniline dyes. He says that has become an industry of great importance in Germany, and where he is located, at Basle. He says that every German university has a professor whose sole business is to investigate, study, and develop these dyes; and whenever a new dye is discovered it is considered a great achievement, and the discoverer is suitably rewarded. He says that some of these professors get as high as $10,000 a year. Mr. George Shepard Page came to our place about a year and a half or two years ago, and laid this whole matter before one of our directors and myself, and although my brother director is a very skeptical man in regard to anything new, said, I think, after hearing Mr. Page's statement, that it was perfectly feasible—that we could unite Cincinnati, Columbus, Toledo, Cleveland, and possibly Pittsburgh, bringing the coal tar products of those points together and manufacturing them. We certainly do not realize what we ought to realize from our residual products. I remember a remark made by Captain White, of the American Gas Light Association, when he was called upon to make some remarks after his return from England. He said that in many instances the gas works there were not run so much for the gas they produced as for the residual products; that they made more out of the residual products than out of the gas itself. That is one reason why the London Gas Company can sell gas so very low and clear 11 per cent., as they did last year. It is true they have an enormous business—from 165,000 to 170,000 consumers, 1,400 miles of pipe, and everything on the same scale; but in the last report that was published in the London *Journal of Gas Lighting* I attempted to analyze it, as well as I could, and I found that they were getting 55 cents out of every ton that they carbonized for their ammonia. If we could only imitate our English and French friends in utilizing our residual products, we could sell gas pretty low.

Mr. Somerville—The great trouble is that this country is too big. In England sulphate of ammonia is used as a fertilizer instead of guano. Here, when a farmer's land begins to get poor, he moves away to another place. He never uses fertilizers, and therefore has no use for ammonia. It is the same with coal tar. The bulk of the coal tar in the old country is made into creosote, and it is used for preserving timber. Here we have so much timber that there is no necessity for preserving it. I thing the time is approaching when our residuals will bring us something.

Mr. Gimper—Sulphate of ammonia is used in this country, and I believe it is imported from England, but we could just as well supply it ourselves. It is a mistake to say that the reason ammonia is not used here is because there is so much land, for there are places in this country where manures are used, and ammonia for this purpose is imported from England.

Mr. Price—I think Mr. Somerville did not elaborate his idea sufficiently. It is true that one reason why articles for enriching our soil are not in demand is because we have so much land; but it is also because we have so much rich land; but in those sections of the country where the land is beginning to be exhausted manures are used, and there is a large quantity of ammonia manufactured in this country for the purpose of manuring. We have had, for the last 6 years, works for manufacturing our ammonia water into sulphate of ammonia. We have not run it ourselves; a German came there and proposed to build the works if we would give him the room and the ammoniacal liquor, and he would pay us pretty liberally for the liquor. He built his works, which were of a cheap nature, and, not being a very industrious man, but rather given to riding about and enjoying himself, he did not make a success of it; but he made sulphate of ammonia in considerable quantities. After he left the business fell into the hands of some able chemists, who have established works in Boston, New York, Washington, Cincinnati, Chicago, and other places, and they have made a very large amount of sulphate of ammonia, and I have no doubt have made it pay. Sulphate of ammonia is used largely as a fertilizer in the Southern States. A firm in New Orleans makes its own sulphate of ammonia and sells it for manures, for the making of ice, and for the distillation of petroleum. This German that I speak of made a journey to Paris, especially to see if he could learn how to make perfectly pure aqua ammonia for the apothecary's shop.

Mr. Smith, (Grand Rapids)—We make it at our works, and if the different companies would unite together we might save all the sulphur and make sulphuric acid from that, which would be cheaper than paying 3 cents a pound for sulphuric acid, which does not give you very much aqua ammonia, and sell that at 3 or 4 cents a pound. Some aqua ammonia costs 30 cents a pound. For our sulphate of ammonia we get about $80 a ton. A good deal of it has been sent to England at that price.

On motion, a committee of three was appointed, to whom were referred the letter of Mr. Page, and the subject of residual products from coal tar, with instructions to report at the next meeting of the Association.

OFFICERS FOR THE ENSUING YEAR.

Mr. Cosgrove, Chairman of the Committee to whom was referred the nomination of officers for the ensuing year, reported the following:

President—Thomas Butterworth.
Vice-President—J. B. Howard.
Second Vice-President—J. W. Butman.
Secretary—Lee A. Hall.
Directors—A. W. Littleton, Quincy, Ills.; J. O. King, Jacksonville, Ills.; James Somerville, Indianapolis, Ind.; R. A. Dittmer, Troy, Ohio; Thos. Smith, Grand Rapids, Michigan; A. T. Averill, Cedar Rapids, Iowa; H. E. Clark, Kansas City, Mo.; W. B. Mills, Montgomery, Alabama; Frank Beck, Galveston, Texas.

The report of the committee was unanimously adopted.

REPORT OF COMMITTEE ON PRESIDENT'S ADDRESS.

Mr. Lansden, Chairman of the Committee to whom was referred the President's Address, stated that he was ordered by the Committee to make the following report:

That the address be received and filed, and that the Committee had no suggestions to make in regard to it, as the subjects set apart for discussion were sufficient to occupy the time of the Association during its present session.

The report was adopted.

STANDARD MEASURES.

Mr. Lansden moved that the Western Gas Association conform to the standards of measure adopted by the American Gas Light Association.

The motion was carried.

CARBON IN RETORTS.

Mr. Somerville—I would like to call attention to the subject of carbon in retorts. I lit up a new bench of retorts on the 28th of October, 1880, and on April 13th, 1881, I burned out the two top retorts and weighed the carbon I took out of them, and found it to be exactly 200 pounds. This is one hundred pounds from each retort. The amount of coal carbonized during that time was 81 tons for each retort, or 1.15 pounds of carbon per ton of coal carbonized. I would like to know from the gentlemen present whether that was too much or too little carbon to get. The retorts were nine feet long, and the hydraulic seal three-quarters of an inch.

Mr. Smith (Grand Rapids)—You ought not to have got so much, I think.

Mr. Zabriski—I think you did remarkably well.

Mr. Gimper—How long did you have to burn it before you took it out?

Mr. Somerville—About twenty-four hours. It comes out in pieces.

Mr. Gimper—I get out a great deal of it in shells, or scales. Sometimes we have to burn nearly all the carbon out—it sticks so fast to the retorts that it will not come off, or only a small part of it.

Mr. Lansden—I was accosted by a gentlemen from New York, this morning, who wanted to know how much carbon I could furnish him next year, delivered in New York by the car-load. I told him that I could not tell exactly, that I had been burning all that accumulated. He said there was going to be a great demand for carbon. Now, as I want to make the electric light a success, we must stop trying to prevent the accumulation of carbon and produce all we can of it.

Mr. Smith (Grand Rapids)—I had an offer of $3 a ton for it; but I did not think it worth while to take it.

The President—Some years ago I had an offer of $20 a ton for all the carbon I could make. I was not making a great deal; I was running my exhauster pretty close to the line. The last I disposed of I sold for experimental purposes in electricity, and I got five cents a pound, or $100 a ton for it. So, when the electric light men come along, we can afford to go into that business.

Mr. Howard—In regard to the electric light, I say let it come, and let it be a success if it can. There is no use in our opposing it, because if it is going to succeed it will succeed. I do not see any stocks reduced on account of it. If it turns out to be a success, we will no doubt feel the effect of it in many ways outside of our own business, and if we cannot manufacture gas so as to compete with it, then we will have to give it up. Our object should be to produce gas as cheaply as possible. The introduction of the electric light should be an impetus to every gas man to run his works so as to be able to furnish cheap gas. I am satisfied that for domestic purposes gas would be preferable to the electric light, provided it could be had as cheaply.

Mr. Smith (Grand Rapids)—I suppose that next to Cleveland we in Grand Rapids have the most electric lights of any western city. We have about 30 in operation, but for all that our consumption has increased from 300,000 to 600,000 cubic feet every month, right along; and in December we sold over 600,000 cubic feet more than we did the previous year in the same month; in November over 500,000; in January we ran from 300,000 to 400,000 more a month. We have reduced the price of gas to $2, and I think that the more we reduce it the more consumption we get. I would therefore advise all gas men to make their gas as cheap as possible, and to furnish their consumers with good gas.

Mr. Lansden—A thought is suggested to me by hearing the sewing machines at work across the way. I remember 40 years ago, when the sewing machine was invented, I was a boy in a store that carried on a manufacturing business, and it was thought that the business was going to be killed by the sewing machine; but that machine gives labor and occupation to ten thousand times the number that it threw out of employment. There are more candles made to day than were made before gas and coal oil came into use. There is more gas burned to-day than there ever was, although we have the electric light. We sold last month six million more feet than the same month last year. I want to see the electric light a success, because it will fill a want that we cannot fill. I want it understood that I am in favor of electricity in every way that it can be used.

The Convention at this point adjourned until to-morrow morning at nine o'clock.

[To be continued.]

[From the London "Journal of Gas Lighting."]

The Construction of a Concrete Gasholder Tank.

At the eighth half-yearly general meeting of the North of England Gas Managers' Association, held at Newcastle-on-Tyne on Saturday, April 30, Mr. T. N. Ritson (Carlisle) read the following paper:

ON THE CONSTRUCTION OF A CONCRETE GASHOLDER TANK ERECTED AT CARLISLE.

Perhaps there are few subjects which have attracted the attention of gas engineers more within the last few years than the uses of Portland cement in the construction of concrete gasholder tanks; and to-day I have the permission of Mr. J. Hepworth, Assoc. M. Inst. C.E., to lay before you the methods adopted in the construction of the concrete gasholder tank erected by him at the gas works, Carlisle.

The first thing necessary was to ascertain the nature of the ground at the proposed site. For this purpose a well 25 feet deep and 4 ft. 6 in. diameter was sunk some short distance from where the tank was to be erected. The nature of the ground then met with was as follows:—3 ft. 6 in. of vegetable soil, loam, and sandy clay; then 17 feet of gravel and sand; and afterward clay for the remainder (4 ft. 6 in.) of the 25 feet. The boring apparatus further showed the existence of clay at 5 ft. 6 in. lower than the bottom of the well.

The tank was commenced in March, 1878, and completed in October of the same year; the dimensions of it being as follows:

Diameter inside	124 ft. 0 in.
Extreme depth	31 ft. 6 in.

Working depth from top of resting-blocks to top of coping..... 30 ft. 0 in.
Cone 36 feet diameter at top, with an incline of 2 to 1.
Dry well 6 feet diameter by 37 ft. 8 in. deep.

The site being fixed, a circle of the required diameter was marked out and excavated over the whole area to the depth of about 9 feet; the surplus earth being removed by means of carts and barrows, and finally by steam cranes, etc., as the excavation proceeded. In making the necessary excavations for the tank walls and piers, an annular space of the required dimensions was formed, the sides being properly timbered with 14 feet lengths of 9 in. by 3 in. and 11 in. by 3 in. runners and wailings placed vertically, close to each other, and horizontal wailing pieces placed 5 or 6 feet apart around the entire excavation, and wedged with strong timber struts.

Water being met with at a depth of 4 feet, pumping became necessary. The dry well was excavated to the required diameter, and carried a few feet lower than the intended structure, the whole being properly shored and timbered as before. This well was used as a pumping station for a considerable time, and in it was fixed a small Gwynne's patent centrifugal pump, capable of throwing from 20,000 to 25,000 gallons of water per hour. This pump was used for some time, until the water began to make headway, when a second pump (Woodford's patent), of greater capacity than the former, was substituted. This pump was capable of throwing from 60,000 to 70,000 gallons per hour. At the same time the first-named pump was lowered into the well, so as to be in readiness in case of a breakdown. The pumps were driven, by an intermediate motion, by a 20-horse power steam engine.

The nature of the strata met with during the excavation of the tank was as follows: ⅞ inch of vegetable soil, 21 inches of loam, 6 inches of sandy clay, 10 ft. 6 in. of alluvial sand and gravel, 14 feet of clay, 13 feet of running sand with blocks of sandstone, and red sandstone rock, which was only met with on excavating for the pump sump.

Previous to laying in the concrete foundations for the walls and piers, a trench was cut in the bottom of the excavation, and in it were laid 6-inch and 9-inch earthenware pipes, with 4-inch upright junctions, for the purpose of drawing and conveying the water to the pumping station. By this means the tank was kept comparatively free from water. The whole of the bottom of the excavation was then laid with 1-inch boards, and covered with a neat layer of Portland cement, so as to insure a perfectly level foundation. Most of the gravel taken from the excavation was used for making the concrete, the whole being first passed through sieves, and the sand and gravel separated and placed in different heaps. The fine sand so obtained was afterward thoroughly washed, so as to free it from any earthy matter—a thing most necessary before mixing with the Portland cement, and which should have most careful attention when constructing concrete tanks, for should the sand be contaminated with earthy or vegetable matter the strength and impermeability of the concrete are greatly interfered with. The clay met with was of a dull red color, very solid, and comparatively free from earthy and foreign matter. A portion of this clay was used for puddling, the remainder being afterward worked up and made into bricks for other purposes.

When the tank was first designed it was not intended to use any puddle; but on meeting with a much larger quantity of excellent clay than was expected, the engineer decided upon its being used for backing the walls. The clay was specified to be carefully selected, the best and toughest to be used for the purpose, and all sand and earthy matter rejected. When prepared, to be thrown from the level of the tank walls, and in layers not exceeding 7 inches square, and well trodden in layers of not more than 6 inches, so as to insure perfect compactness and impermeability of the material. A layer of puddle 18 inches thick was also laid over the cone. The space left behind the puddle when the timbering was removed was carefully filled in with earth, thoroughly consolidated by ramming as the work proceeded.

Though puddle was used in the formation of this tank, there can be little doubt that without its aid the tank would have been tight. At the same time, when constructing tanks where clay is at hand, as in this case I should think it always desirable to use it. Whether puddle is used or not, it is necessary that great care should be taken to back or support the concrete, in order to resist the pressure of water inside the tank.

The method of mixing the concrete was as follows:—Large wooden platforms about 20 feet square, made of 9 in. by 3 in. deals, were laid on the ground in convenient places, for the purpose of mixing the concrete upon. Wooden boxes 15 or 18 inches deep, without top or bottom, and capable of holding about half a cubic yard, were used for measuring the material. On the top of these boxes was fixed a straight edge, for the purpose of striking the levels each time they were filled.

The proportions of the materials used for making the concrete were as follows:—1 part of Portland cement, 2 parts of clean, sharp sand, 2 parts of gravel broken into pieces not more than 1½ inches diameter. The whole, after being measured out on the platform, was turned over twice dry, and once again thoroughly mixed, when a sufficient quantity of clean water was added through a "rose," and the whole turned over again three or four times wet. Immediately after being mixed the mass was placed in barrows and thrown down a suitable wood shute into moulds. These moulds were made of wood, and were about 2 feet deep, and formed to the proper curvature and scantlings of the tank walls. Several carpenters were employed to remove, fix, and alter these moulds to the necessary dimensions of the walls. The concrete was deposited in layers of not more than 6 inches, and not more than 12 inches in depth was allowed to be built in a day. Great attention was paid to the thorough cleansing, roughing, and wetting of the set surface previously laid, before any additional layer of cement was built upon it, so as to insure perfect contact and cohesion. The footings were prepared by laying on the whole surface of the puddle, at the bottom of the annular space, a floor of concrete 3 feet thick.

The resting-blocks and inlet and outlet pipes being laid in position, the erection of the tank walls was commenced. The mould or framework before mentioned was placed upon the work previously laid, and the space between filled in with concrete, the whole mass being properly levelled and filled in against the sides of the mould. Throwing concrete from a height should always be avoided.

The thickness of the walls at bottom is 5 ft. 3 in., tapering on the outside to 3 feet at top, the total height being 31 ft. 6 in. At every 2 feet in height in the tank wall is fixed hoop iron 1¼ in. by 1-12th in., placed 4½ in. apart, riveted together with two ⅝-inch rivets at each joint, intersected crossways by and riveted to shorter lengths of hoop iron of the same dimensions.

For the purpose of fixing the channel guides, small apertures were left in the tank walls by means of wooden boxes or cores, and when the belts were fixed in position these apertures were filled in with neat cement, and well grouted in. The mooring plates are fixed 15 feet from the top of the tank walls in each pier, these plates being fixed in position as the work proceeded; the holding-down bolts were also securely cottered in at the same time. These holding-down bolts were then encased in thin sheet iron tubes of sufficient diameter to give the bolts a little play. The tubes having a slight taper toward the bottom, are easily withdrawn on the completion of the work. The cavities were afterward filled in with neat cement. The top of the tank walls and piers are finally surmounted with an ashlar stone coping 9 inches thick.

The trammel or radius-bar used was simply a long rod made of 1¼-inch wrought iron tube, and the end ringed to an iron center-pin fixed in a stone in the center of the tank. On the end of this rod was hung a lead plumb-bob.

On the completion of the tank walls the interior of the tank was excavated, and the cone formed. After being puddled, a bed of concrete 18 in. thick was laid over the whole area, and finished on the top with a center pier.

In order to commence with the erection of the walls of the dry well, another pump sump had to be excavated and the pumps refixed therein. This sump having been got into working order, the walls of the dry well were commenced and erected in a similar manner to the tank walls. The wall is 37 ft. 8 in. deep and 6 ft. in diameter inside, the thickness of the walls at the bottom is 2 ft. 6 in., tapering on the outside to 2 ft. at the top. The bottom of the well is in the form of an inverted arch. The space between the tank and the well is filled with puddle. For some time after the gasholder had been at work there was some little difficulty caused by water percolating through the walls of the well, necessitating the use of a hand pump. This pump was fixed on the cover on top of the well, the pipes thereto being so arranged that the pump served to empty the syphons of the inlet and outlet pipes, and to empty the well of water. This incurred considerable expense in labor, and finally the water pipes were rearranged and the well partly filled with puddle. This stopped the slight leakage in the well, and the pump is only used for emptying the syphons. The quantities as taken out for our own guidance were as follows:

Excavation timbered	5,948 cubic yards.
Ditto of interior	7,439 cubic yards.
Wood boarding under excavation	4,723 super. feet.
Concrete in foundations, walls, piers, etc	3,308 cubic yards.
Cement rendering	2,960 super. feet.
Puddle	1,249 cubic yards.
Stone	1,247 cubic feet.
Hoop iron	4 tons.

I may also add that about 800 tons of cement was supplied under the specification.

The whole of the inside of the tank walls, and the inside face of the cone, after being thoroughly washed and cleaned, was rendered impermeable with a coating of neat cement ¼-inch thick. The outside face of the dry wall was also rendered.

The cement used had to be supplied to the following specification: "The

cement to be of the best quality, ground extremely fine, and must weigh not less than 115 lbs. per the imperial striked bushel, as poured into the measure. The cement must not contain more than 15 per cent. of its bulk that will not pass through wire gauze having 2,500 meshes to the inch. It must, when ganged neat, set perfectly hard under water in seven days, by which time it must be capable of bearing a tensile strain of 800 lbs. on a cross section of 2¼ square inches." I must not omit to mention the general specification stipulated that "the contractor must provide a suitable dry shed or other building in which the cement shall be stored in bulk after being emptied from casks or bags, and no cement shall be used that has not been so kept for at least 14 days."

An analysis of the cement used showed the following results:

	Parts.
Lime	60.88
Silica	23.16
Magnesia	1.01
Alumina	7.58
Peroxide of iron	3.00
Potash	0.72
Soda	0.31
Sulphuric acid	2.60
Sulphur	0.05
Chlorine	trace.
Peroxide of maganese	trace.
Phosphoric acid	0.08
Moisture	0.77

I may add, in conclusion, that the tank is a complete success, perfectly cylindrical, and thoroughly water tight—so much so, indeed, that a fall of rain can be measured—and so far has shown no sign of fracture in any way.

Discussion.

Mr. C. Sellers (York) thanked Mr. Ritson for his interesting data upon the construction of a concrete gasholder tank, but thought the paper would have been much more complete if Mr. Ritson had given the meeting a comparative statement of the real cost of the concrete tank at Carlisle, with the estimated cost of the same tank in bricks. He apprehended that such a comparison would be made before concrete was decided upon. Concrete might be cheaper than bricks and clay in Carlisle, for Mr. Ritson told them that good gravel for concrete had been obtained from the excavations, and therefore clay would probably be a scarce article. In York, where his (Mr. Seller's) Company were engaged constructing a tank, the case was different. Good clay for puddle was found in the excavations, and within their own premises, sufficient for their purpose, whereas they had to fetch rough gravel for concrete from Brough—a place 40 miles off; and these local peculiarities determined them in favor of bricks, as being, in their case, cheaper than concrete. But, even under the most favorable circumstances, he believed that bricks would be cheaper than concrete in nearly all tanks of less than about 100 feet diameter; and, if there was any doubt about it, he apprehended that the local peculiarities named of a gasholder site must determine the question. Then there was another matter. Brick tanks were as old as gas itself, and should not be lightly discarded; for when properly constructed they had always been satisfactory, while he believed the first concrete tank, built by Mr. Livesey, was only about ten years old, and hence, in point of age, was in its infancy. He should like Mr. Ritson to clear up the comparative advantages and cost of each principle.

Mr. W. Brown (New Cumnock), speaking on Mr. Seller's question as to the relative cost of bricks and concrete, said it depended entirely on the distance that the different materials had to be brought. He had put a bridge across a river, and built the piers of concrete; and in this case the materials for making concrete were found on the spot, while bricks would have cost 12s. per 1,000 for carriage alone, and stone also would have been equally dear. Therefore concrete was the cheapest. As for durability, the piers had stood the test of one of the severest winters ever known, and were likely to prove a good lasting structure.

Mr. W. Ford (Stockton) said his experience had all along been in favor of bricks and puddle for tanks, when these materials could be obtained cheap and good. He thought a brick tank preferable to a concrete one, and it had this further advantage, that it had stood the test of time. Concrete tanks were of comparatively recent date, and might be said to be still upon their trial.

Mr. W. J. Warner (South Shields) said no doubt locality had much to do in deciding the question of bricks or concrete for gasholder tanks. He recommended the storing of the old materials to be found in gas works, for the making of concrete.

Mr. J. Hepworth (Carlisle), referring to the question of Mr. Sellers as to the relative cost of bricks and concrete, said he found there was a saving of 25 per cent. in favor of concrete. Of course, as had been said, the situation of the tank must determine the decision of the engineer as to the materials for building it. In another case in which he was interested he found that bricks would be cheaper than concrete.

Mr. Ritson, in reply, thanked the members for the reception he had received, and also for the observations that his paper had drawn forth.

[From the "Review of Gas and Water Engineering."]

Otto v. Linford.—*Re* the Gas Engine.

The above case, commenced several months since, was heard at the High Court of Justice, Chancery Division, before Vice-Chancellor Sir James Bacon, on the 23d–30th ult. Mr. Aston, Q.C., Mr. Hemming, Q.C., and Mr. Lawson were counsel for the plaintiff; and Mr. Kay, Q.C., Mr. Brett, and Mr. H. Cunningham for the defendant.

The action was brought by Mr. Nicolaus August Otto to restrain alleged infringements by the defendants, Messrs. Charles Linford and Company, of Leicester, of letters patent, dated 17th of May, 1876, and granted to Mr. C. D. Abel, the agent of the plaintiff. The defendants denied any infringement, and also disputed the validity of the plaintiff's patent, on the grounds that the first and second claims in the plaintiff's specification were claims for a principle, and that the mechanical means for carrying the principle into effect were not particularly described; and that the patent had been anticipated by several prior patents. The plaintiff claimed—

1st. To be the first to introduce a cushion of non-combustible gas between the piston and the explosive.

2d. The first to draw in behind a piston first air and then air and gas mixed.

3d. The first to utilize the heat generated by the explosion in expanding the cushion of air.

4th. The first to compress a charge by the working piston in the working cylinder.

The defendants stated, by their answer, that it was not correct that, in the gas motor made by them, a charge of combustible and incombustible fluid was compressed, or that any such charge had been drawn into the cylinder. In their engine the compressed charge, when ignited, propelled the piston during the next out stroke, and the products of combustion were partly expelled from the cylinder by the next instroke. In the plaintiff's engine, the slide valve admitted air during the remaining portion of the stroke; whereas in Linford's engine the slide valve admitted a combustible charge of air and gas during the whole of such stroke. The piston was propelled by the explosion of the charge, the products of combustion were partly expelled by the next in-stroke of the piston, and a scavenger charge of air was afterwards drawn in to expel the remaining products.

Mr. Aston, Q.C., in opening the plaintiff's case, explained the principle of the gas engine. If into the charge chamber of an ordinary cylinder working an ordinary piston were introduced a mixture of eight parts air and one of carburetted hydrogen, on igniting this mixture by any convenient means, an explosion would ensue which would drive the piston violently forward. If we had a similar chamber at the other end of the cylinder, we might repeat the process, and draw the piston back again. Or we might trust to the gradual cooling of the remains of the exploded charge, when a partial vacuum would be made and the piston released. These were the only two systems in use at the time when the Otto engine was invented. The defects of the engine in use at this time were, that the explosion produced a violent shock, and there was a waste of heat. About 1876, it occurred to Mr. Otto that, if, instead of using a charge of combustible mixture only in the cylinder, he could introduce something that would take off the shock and also utilize the heat, he could obviate these defects. So he provided for the introduction into the charge chamber—first of a certain charge of air (A), and secondly, he put behind that a charge of combustible mixture (B); by communicating as before the light of a gas jet to the combustible mixture (B) he allowed it to be fired. The charge of air (A) acted as a cushion and took off the suddenness of the shock, and also took up some of the heat, by which means it expanded and did work. After the explosion the cylinder would be full of the products of combustion and unconsumed air. By the action of the fly-wheel the piston would be brought back, and would thus expel a certain portion of the products of combustion. When, by the continued action of the fly-wheel, the next charge was drawn in, the cylinder would contain (A) air, (B) combustible charge, (C) residual products of combustion, and these would be mixed, but not thoroughly, a large portion of the combustible remaining at the end next the point of ignition. When, by the action of the fly-wheel, the piston returned, compressed the charge, and in that compressed state it was fired, there was gradual combustion and gradual development of heat and force. The method of introducing and compressing a charge was known prior to 1876, but no gas engine was ever made and used which worked on this principle.

After reading and commenting on the specification of the plaintiff, Mr. Aston proceeded to explain how, by the use of a cylinder longer than the

piston stroke, compression could be effected in the same cylinder in which combustion took place. The work of compression was important, since, while at ordinary atmospheric pressure about 1 part of gas to 8 of air was required to form a combustible mixture, in a compressed form we might have a combustible mixture in as high proportion as 15 or 16 of air to 1 of gas. He next called attention to a statement in the specification to the effect that "it was not always necessary to draw in a charge partly consisting of air and partly of combustible mixture," and showed that the specification covered the whole cycle of operations already referred to.

Mr. Aston said it had been found that Messrs. Linford were making and selling gas engines, differing in form, but constructed on practically the same principles. The defendant varied the number of his out strokes and in-strokes, and the engine he made was different in shape, but in the long-run he produced the same results as the plaintiff in the same manner. The defendant had two pistons working in one cylinder, and these, instead of receding from and approaching the chamber at the end of the cylinder, approached one contained between them, in the middle of the cylinder. These two pistons are connected by beams, links, and cranks, to a fly-wheel shaft. Mr. Linford claimed in his specification a special construction of gas engines, by which a charge can be admitted, compressed, and ignited within the cylinder during one revolution of the crank. The object of the second part of his invention is to admit, compress, and ignite separate charges of air and air and gas. Mr. Aston, having traced the action of his engine through all its stages, claimed that the action was in all respects identical with that of Otto's engine.

Mr. T. J. Bramwell was called, and examined as to the defects of the older forms of gas engines, and as to the similarity of plaintiff's and defendant's engines. He held that the two inventions were practically identical, and explained the meaning which according to his view should be attached to the plaintiff's specification. The defendant worked his slide by gearing, geared 3 to 1 to the revolution of the crank-shaft, while the plaintiff worked his slide by gearing that is geared 2 to 1; this made no substantial difference.

Cross-examined by Mr. Kay: –Had not had much to do with gas engines. Could not say that a charge of gas and air had not been admitted to a cylinder till Mr. Otto had done it. A long discussion ensued as to whether there was or was not a draughtsman's error on a drawing put in, Mr. Bramwell maintaining that there was an error, which would be so obvious to a workman that it would not prevent him from making an engine which would work. The cross-examination was then directed to show that the plaintiff's specification was imperfect and that it did not state precisely the proper proportion of gas and air.

Mr. John Imray was then called, and explained the state of knowledge on gas engines at the time of plaintiff's patent, 1876. He concurred with Mr. Bramwell's description of Otto's engine and the mode of its operation. He considered the essence of the invention was, effecting the combustion in the presence of a considerable body of elastic fluid, amongst which the combustible particles were disseminated in a graduation—the combustible mixture strongest next the point of ignition and gradually weaker towards the piston. He admitted the error in the drawing, but considered the specification gave sufficient information to enable a workman to make an engine that would work. He considered that the defendant's engine acted on the same principle as the plaintiffs engine.

Cross-examined by Mr. Cunningham: —Defendant obtained the same result as the plaintiff by admitting the combustible mixture, after the air and residual products, into the cylinder. Mr. Cunningham attempted to show that this was identical with Johnson's specification of Lenoir's engine, 1860. Witness thought Lenoir proposed the crude idea of what he should like to do, but did not show efficient means of doing it; and that he was wrong in his whole idea. Witness was also cross-examined with respect to other prior specifications to plaintiff.

Mr. C. D. Abel proved securing the patent for Mr. Otto.

Mr. T. J. Bramwell was recalled and further cross-examined by Mr. Kay as to several mechanical details, also as to Johnson's specification of Lenoir's gas engine, 1876.

Mr. Nicolaus August Otto was sworn, and examined by Mr Hemming. He explained the essence of his invention, 1876, and said there were two modifications of his gas motor, one to work with and the other without compression.

Mr. F. Crossley was called, and examined by Mr. Aston. Over 2,000 engines had been made on the principle of the plaintiff's specification, with some small improvements in detail added by himself.

In cross-examination, Mr. Kay after referring to the part taken by witness in designing the gas engines, proceeded to notice a subsequent patent, 1877, which dispensed with the stratified charge, and introduced into the cylinder a combustible gas diluted with air to a greater degree than is necessary for its complete combustion. Witness considered this good for small, but not for large engines. The combustible mixture was compressed in all the engines sold by witness.

Re-examined by Mr. Aston:—The combustion would be slower with the "uniform" charge than with the "stratified" one. The charge described in the 1877 patent was practically the same as that of the 1876 patent.

Mr. Kay, in defence, criticised the plaintiff's specification and the scientific evidence. The notion of gradual combustion had been dropped, and the merit of the invention was the use of heat that would otherwise be lost. He put it to his Lordship that this was the whole of plaintiff's claim, for Mr. Bramwell had said there was no novelty in the machinery. Plaintiff's claim was to have a patent right for introducing air into a cylinder, and combustible gas mixed with air separate from the first air introduced. The Court would have to consider whether it was possible to have a patent for a thing of that kind. It was not possible, according to patent law, to have a patent for a mere principle, disconnected from a particular mode of applying it. This was a bad patent, because it was for a principle. The plaintiff patented, not an engine, but a process, and this process had already been anticipated by Johnson. The learned counsel quoted a decision of Lord Westbury, to show that a specification is of necessity a publication. He then proceeded, with the aid of sectional models, to show the points of similarity between Johnson's patent and the plaintiff's. As to the second part of the patent, which was for compressing the mixture, it was far too wide to be a good subject for a patent, being a claim for a process. This matter of compression was anticipated by Barnett, in 1838; also by Boulton, in 1868. The Linford gas engine differed more from Crossley's than the latter from Johnson's, Lenoir's, Barnett's, or Boulton's; therefore either plaintiff's patent was hopelessly bad, or the defendants did not infringe it.

The first witness for the defence was Mr. H. Gardiner, who was examined by Mr. Brett. He pointed out distinctions between the plaintiff's and the defendant's engines, and proved the existence, some years ago, of a Lenoir engine in practical operation. He showed, with the aid of a model, that an engine made according to the drawing attached to plaintiff's specification would not work, and said that an ordinary workman could not make an engine by the specification.

Cross-examined by Mr. Aston, witness said there was a description of Lenoir's invention in the "Mechanic's Journal" for August, 1866.

Mr. R. C. May, examined by Mr. Kay, agreed with Mr. Bramwell as to the error attached to plaintiff's specification. A good workman, however clever, must make a new drawing and set the engine out before he could get it to work. He considered plaintiff was anticipated by Johnson's specification, in the matter of admitting air first, and by Barnett and Boulton with regard to compression of the charge. The engines of the plaintiff and defendant were totally different in mechanical arrangement, but they effected the same object.

Witness was cross-examined at a great length by Mr. Aston upon the mechanical details of the various inventions under consideration, the object being to show that Barnett's, Boulton's, and Johnson's (Lenoir) engines were substantially different from that of the plaintiff. It would be impossible to render this part of the trial clear without drawings and models.

After hearing further speeches of counsel, the Vice-Chancellor delivered judgment as follows:—It seems to me that, although a great deal has been said and a great deal of time occupied, the question is merely one of law. The first thing I have to consider is, whether the plaintiff's specification does sufficiently inform the public of the nature of the invention on which the plaintiff relies. I must ascertain the state of public knowledge at the time when plaintiff took out his patent. A man who proposes to secure a patent must make a full disclosure of the invention which he claims, and the means by which he proposes to carry it into practical effect, and must prove that it is a "new manufacture." It is not a new discovery that a gas motor engine may be made. Bennett's specification anticipated that. I must assume that, from the date of Bennett's specification, the whole world knew that, by the explosion of a mixture of carburetted hydrogen and air, motion could be given to machinery. The patent of Johnsons seems to me to cover the whole subject of discussion. It appears that the great invention on which the plaintiff relies is, the introduction of a quantity of air into the cylinder before the combustible mixture. In the examination of witnesses it is admitted that Johnson's invention is in substance substantially the same as that of the plaintiff, but that it is not workable; and therefore, I have an argument addressed to me that, as the defendant has not proved Johnson's engine to be workable, the knowledge conveyed to the public by Johnson's specification is not available for public use. It is not necessary for the defendant to prove what Johnson did or did not do with his engine. Plaintiff nowhere claims to be an inventor of anything. He says—"In making a gas motor engine, this is the process I adopted," and describes a process perfectly identical with Johnson's. Because he lets in a supply of cold air independently of the combustible mixture, he claims to hold this as a perfect invention. I think defendant is entitled to have all the knowledge and apply all the means which Johnson has indicated, and it is not in dispute that he has

done the thing described by Johnson in his patent, and he has made his machine in a different form. Unless the words of Johnson's patent can be obliterated, or it can be decided that Johnson's patent never was an acting and useful machine, there is no ground whatever for saying that the plaintiff is an inventor. There is no invention in letting in the atmospheric air separately from the combustible mixture, and the other details are the same. In my opinion there is no ground whatever upon which the plaintiff can insist that the defendant has invaded his invention. It might be doubtful whether the principle which the plaintiff relies upon is one that would sustain a patent, but it is not necessary to go into that. On the ground that the invention the plaintiff claims is literally and entirely described in Johnson's patent, I am of opinion that the plaintiff fails in his demand before me.

A New Safety-Lamp.

Mr. William Crossley, of Glasgow, read a paper some time ago, before the South Wales Institute of Engineers, on "Safety Lamps and Preventions of explosions in Collieries." The principle on which Mr. Crossley secures the attainment of his object is, that the safety-lamp should be worked with atmospheric air entirely extraneous to the colliery itself, which could readily be done by distributing air pipes through the colliery main roads and workings, exactly in the same manner in which gas pipes are distributed now through the various streets of towns, and throughout houses. The pressure required would be about equal with that of gas in an ordinary supply-pipe, and it could readily be supplied from the gasholder, which could, in turn, be kept full by means of a "fan" or other blowing appliance. Mr. Crossley furnished the following description of his lamp—

"The lamp is entirely closed to the outside atmosphere, except the outlets at the top for the escape of the products of combustion. It consists of an ordinary or other suitable oil vessel and wick; a closed air-reservoir which is used for distributing the air to the parts required for keeping up combustion, and for keeping the lamp cool; and further of two glass cylinders arranged concentrically, with small air space between them. The air for combustion passes up through the inner glass cylinder. There is also a current of air between the outer and inner glass cylinder, which keeps the outer one cool, and, mixing with the products of combustion from the inner one, also cools them to a point at which they may be safely allowed to escape.

"His scheme also includes taking the lamps from the place where they are cleaned and prepared to the working parts of the colliery, which he proposes to affect by the aid of a tank bogie, which is so arranged as to contain atmospheric air at a high pressure—say, 200 to 300 lbs. per square inch. This bogie is fitted with small stop cocks, and capable of carrying at least 100 lamps at a time for distribution in the working. The lamp can also be arranged to burn in the same manner as an ordinary safety lamp during the time it is being carried from the place where it is prepared to the place where it is to be fixed for use."—*Ironmonger.*

The Deepest Coal Pit in Britain.

After six years of patient toil involving a deeper descent into the bowels of the earth than has yet been reached by any similar effort, the Ashton Moss Colliery Company have, within the past few days, achieved the object of their desire—the proving of valuable coal beds upon an unworked part of Ashton Moss. Brief accounts of the operations of the company have from time to time appeared in our columns; the circumstance being notable not only from the prospect in view, but also latterly from the extraordinary depth to which the shaft has been carried. The company consists of the Earl of Stamford and Warrington, Mr. Benjamin Whitworth, M. P., Mr. John Greenwood (Manchester), Mr. Joseph Walker (Manchester), and Mr. James Wylie (London). In 1874 the company commenced sinking operations, with the view of finding the Four-feet-Mine, which was being worked in other parts of the coalfield. At a depth of 450 yards the mine was proved and several headings were driven by way of testing the bed, which, however, was found to be not of sufficient thickness to be workable. The proprietors did not build their hopes upon this mine, and nothing despairing made preparations for sinking a shaft 250 yards deeper—in all 700 yards. This depth, greater than that of the Astley Deep Pit, having been reached, and not having overtaken any coal of a workable character, the engineers, not, it will be imagined, without some misgivings, directed that borings should be taken. Accordingly boring operations were begun, the results of which were such that orders were given to sink further. The consummation of all this labor, perseverance and expense were reached when, just six years after the ground was first broken, the workers touched the Great Mine, a seam of coal six feet thick, and lying at a depth of 895 yards from the surface, or 897 yards including the seam itself. At a depth of 950 yards lies the Roger Mine, four feet thick, and below this are supposed to exist several workable seams of coal, including the Black Mine and the Cannel Mine, both of which are got at Ashton.

The coal is a house-fire coal, with coking properties, and is most valuable for position—being so near the large centres of population—available quantity, and excellence. The field that can be worked by the company is about 2000 acres in extent, extending from Guide Bridge to Droylsden on one side and on the other from Fairfield to Ashton. A second shaft is now being sunk, being, indeed, but 200 yards short of the first shaft, and when working operations have fairly begun—which is expected to be in six months—the mines are calculated to yield from 1500 to 2000 tons per day, and plant is being put down with that view. In the sinking operations the mines have encountered no fewer than 60 seams or strata of coal, cannel, or shale, varying from three inches to more than two feet in thickness, but none until now of a workable character. The temperature taken at a depth of 860 yards was 78°F. The Great Mine—the one, that is, which has just been proved—has been worked from the outcrop to within a distance of 2000 yards at the Lord's Field Colliery, and about 1000 yards by the Dukinfield Coal and Cannel Company, fair rise and dip. The first-named pit pierces the seam vertically at a depth of 130 yards, and the Chappel and Dewsnap pits of the latter company strike it at about 250 yards. In comparison with other pits the Ashton Moss pit, as already stated, is the deepest in England. The sinkings and borings have penetrated to a depth of 1050 yards; the sinkings alone have reached 895 yards, and this will soon be increased to 950 yards. The Astley Deep pit, at Dukinfield, is about 686 yards deep, whilst the Rose Bridge pit, at Wigan, and the Moss pit, situated in the same locality—which have hitherto been reckoned the deepest in the country—extend to a depth of about 820 yards.

The consulting engineers for the Ashton Moss Colliery Company are Messrs. J. and P. Higson, of this city; Mr. John Greenwood, Jun., is the resident engineer and superintendent; and Mr. R. Liddell is also engineer. Mr. James Stanfield, of Ashton, is the contractor—*Manchester Guardian.*

Electric Lights that Went Out.

The sudden failure of the electric lights which illuminate a part of Broadway was one of the incidents of the rainstorm of Tuesday night. All the lights on one of the circuits supplied by the Brush Company went out about 12 o'clock, and the street was in darkness for more than an hour. Mr. C. M. Rowley, the general manager of the Brush illuminating company, said yesterday to a *Tribune* reporter:

"It took us some time to find out what the difficulty was, but it was remedied within an hour and will not occur again. The posts and hoods of our lights are of iron, and of course perfect conductors of electricity if once a current touches them. The heavy rainfall carried a rush of water into the hoods, probably through the chimneys or the holes through which the insulators enter the top, and the water established a connection between the wire and the iron of the hood, so that the electricity was attracted down to the ground instead of to the carbon points. The defects have been repaired, and no more iron posts will be put up so that a recurrence of the failure need not be feared."—*Tribune,* June 9th.

Oil and Vapor Stoves.

OEFICE OF CITY ENGINEER,
TROY, N. Y., May 8, 1881.

To the Editor of the Sanitary Engineer:

Have you any information in regard to the convenience, efficiency and safety of what are advertised as "oil stoves," and is there any one of them better than the others?

Yours truly,
R. M. HASBROUCK.

[We referred this letter to the Superintendent of the New York Board of Fire Underwriters, who sends us the following reply]:

BOARD OF FIRE UNDERWRITERS,
NEW YORK, May 23, 1881.

To the Editor of the Sanitary Engineer:

The expert of our Board has had a number of "oil" and "vapor stoves" submitted for his examination, with a view to obtain an approval. Not one, thus far, has been approved. We consider them unsafe, and can not commend the use of any of the many patterns.

Yours truly,
JAS. HARRISON,
Supt.

—*Sanitary Engineer.*

A NOVEL METHOD OF RAPID LIGHTING.—At the Royal Palace in Berlin, forty thousands of wax candles are instantaneously lighted by a single match. The wicks are previously connected by a thread spun from gun cotton, on lighting one end of which all the candles are lighted simultaneously and thus the whole of the seven hundred apartments are lighted at once.—*Sci. Press.*

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.

(with W B Scott & Co.,)

34 Pine Street, New York City.

June 16, 1881.

☞ All communciations will receive particular attention

☞ The following quotations are based on the par value of $100 per share.

	Capital.	*Par.*	*Bid.*	*Asked*
Gas Co.'s of N. Y. City.				
Central	$166,000	50	60	65
Harlem	1,800,000	50	80	85
" Bonds	170,000			103
Manhattan	4,000,000	50	185	190
Metropolitan	2,500,000	100	146	145
" Scrip	1,000,000	..	102	103x
Mutual	5,000,000	100	65	70
" Bonds, go'd.	900,000	1000	100	104
Municipal	1,500,000	100	160	165
" Bonds	750,000		106	110
New York	4,000,000	100	95	98
Northern	270,000	50	—	100
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	114	118
Citizens	1,200,000	20	45	50
" S. F. Bonds.	320,000	1000	100	105
Fulton Municipal	1,500,000	100	60	65
Peoples	1,000,000	10	35	40
" Bonds.	290,000		101	104
" "	250,000	...	70	75
Metropolitan	1,000,000	100	60	65
Nassau	1,000,000	25	55	60
" Ctfs.	700,000	1000	95	100
Williamsburgh	1,000,000	50	60	65
" Bonds		...	98	103
Kings Co	135,000	100	55	60
" Bonds	40,000	—	—	—
Richmond Co., S. I.	300,000	...	70	75
Out of Town Gas Companies.				
Buffalo Mutual, N.Y	750,000	100	72	76
" Bonds	200,000	1000	95	100
Citizens, Newark	918,000	50	85	90
" " Bds.	124,000	—	105	10
Chicago Gas Co., Ills			125	—
Cincinnati G. & C. Co.			178	180
Consolidated, Balt.			66	67
Bonds			107	—
East Boston, Mass		25	114	120
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	140	144
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
Jersey City	750,000	20	145	155
Jacksonville, Ill	120,000	50	100	...
Lewistown Maine	400,000	100	—	100
Laclede St Louis Mo	1,200,000	100	108	110
Montreal, Canada	2,000,000	100	153	154
New Haven, Conn		25	132	—
Oakland, Cal			30	31
Peoples, Jersey City		...	95	100
" " Bds.				5
Pittsfield, Mass			120	130
Rochester, N. Y		50	70	80
" Citizens		100	30	35
Woonsocket, R. I	150,000	100	80	...
Wilmington, Del		50	174	...
Yonkers		50	30	32
Rondout & Kingston			75	80
St. Louis Missouri	600 000	50	250	254
San Francisco Gas-Co., S. Fr'isco Cal.			72	73
Toledo, Ohio			95	97
Troy, Citizens	600,000	100	—	—
Washington, D. C	1,500,000	20	190	200
" Scrip	500,000	20	150	160

200 shares of Manhattan sold at auction at 185½ and 186½.

Advertisers Index.

Page

GAS ENGINEERS.

William Farmer, New York City ... 262
G. Warren Dresser, New York City ... 281

GAS WORKS APPARATUS AND CONSTRUCTION.

Herring & Floyd, New York City ... 283
T. F. Rowland, Greenpoint, L. I ... 283
Deily & Fowler, Phila., Pa ... 283
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 283
Stacey Mfg. Co., Cincinnati, Ohio ... 283
Bartlett, Hayward & Co., Baltimore, Md ... 283
P. Munzinger, Phila., Pa ... 283
Brown & Owen, Phila., Pa ... 283
Morris, Tasker & Co., Limited, Phila., Pa ... 283

GAS AND WATER PIPES.

A. H. McNeal, Burlington, N. J ... 282
Gloucester Iron Works, Phila., Pa ... 282
R. A. Brick, New York City ... 282
James Marshall & Co., Pittsburgh, Pa ... 282
R. D. Wood & Co., Phila., Pa ... 282
Warren Foundry and Machine Co., Phillipsburgh, N. J ... 282
Mellert Foundry and Machine Co., Reading, Pa ... 282

WASHERS AND SCRUBBERS.

G. Shepard Page, New York City ... 254

RETORTS AND FIRE BRICK.

J. H. Gautier & Co., Jersey City, N. J ... 280
B. Kreischer & Sons, New York City ... 280
Adam Weber, New York City ... 280
Laclede Fire Brick Works, St. Louis, Mo ... 280
Brooklyn Retort and Fire Brick Works, Brooklyn, N. Y ... 280
Borgner & O'Brien, Phila., Pa ... 280
Gardner Brothers, Pittsburgh, Pa ... 280
Henry Maurer, New York City ... 280

DIETERICH'S REGENERATOR FURNACE.

Charles F. Dieterich, Baltimore, Md ... 286

GAS METERS.

Harris, Griffin & Co., Phila., Pa ... 286
American Meter Co., New York and Philadelphia ... 287
The Goodwin Gas Stove and Meter Co., Philadelphia, Pa ... 287
Hemme & Mellhenny, Phila., Pa ... 287

GAS STOVES.

The Goodwin Gas Stove and Meter Co., Phila. Pa ... 264
American Meter Co., New York and Philadelphia ... 279

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y ... 280
Chapman Valve Manufacturing Company, Boston, Mass ... 280

EXHAUSTERS.

P. H. & F. M. Roots, Connersville, Ind ... 281
Smith & Sayre Manufacturing Co., New York City ... 281

GAS COALS.

Penn Gas Coal Co., Phila., Pa ... 285
Perkins & Co., New York City ... 284 285
Cannelton Coal Co., New York and Philadelphia ... 285
New York and Cleveland Gas Coal Co., Pittsburgh, Pa ... 285
Newburgh Orrel Coal Co., Baltimore, Md ... 285
Despard Coal Co., Baltimore, Md ... 285
Tyrconnell Coal Co., Baltimore, Md ... 285
Fort Pitt Gas Coal, Pittsburgh, Pa ... 284
Chesapeake and Ohio R.R Coal Agency, N. Y. City ... 285

GAS ENGINES.

Schleicher, Schumm & Co., Phila., Pa ... 278

STEAM STOKERS.

A. Q. Ross, Cincinnati, Ohio ... 288

PURIFIER SCREENS.

George D. Cabot, Lawrence, Mass ... 278

BURNERS.

G. Gefrorer, Phila., Pa ... 280

PURIFYING MATERIAL.

Connelly & Co., New York City ... 277

STEAM BLOWER FOR BURNING BREESE.

H. E. Parson, New York City ... 278

PROCESSES.

Gwynne Harris New York City ... 282

EDGE'S PROCESS. REMOVING CARBON

D. D. Flemming, Jersey City, N. J ... 278

GAS FIXTURES.

Mitchell, Vance & Co., New York City ... 281

CEMENT.

S. L. Merchant, New York City ... 281
F. O. Norton, New York City ... 281

BOOKS.

Economy of Gas as a Fuel ... 284
Journal des Usines a Gaz ... 307
Gas Analyst's Manual ... 284
Scientific Books ... 282
Cathels' Gas Consumers' Manual ... 287
Fodell's Book-Keeping ... 287
Review of Gas and Water Engineering ... 287

Purifiers For Sale.

FOUR SECOND-HAND PURIFIERS, 10x16 ft.

With wet center seal, 12-inch connections. All in fair order. Can be delivered Aug. 1st.

527-3t Portland (Me.) Gas Light Co.

GAS EXHAUSTER FOR SALE.

ONE MACKENZIE EXHAUSTER,

Complete, with by-pass, valves, etc.; 8-inch connections. Good as new, and cheap. Address

Wilkes Barre Gas Co.,
527-3t Wilkes Barre, Pa.

ENGAGEMENT DESIRED

AS SUPERINTENDENT OF GAS WORKS.

Has had 15 years' experience; thoroughly understands the business in all its departments—the construction of gas works, manufacture of gas, laying of street mains, inspection of gas fittings, or is a practical gas fitter. Can make own drawings of works, and thoroughly understands and can perform the secretary duties of the office. Can give the highest references if necessary.

528-2t Address "Superintendent," Care this Journal.

FOR SALE.

Gas Works,

IN A CITY OF 12,000 POPULATION.

Buildings and Works in First-Class Shape.

Popular with City and Consumers. Income, $7,000.

WILL BE SOLD REASONABLE.

Address

CHAS. A. LAMB,

159 LAKE ST, CHICAGO, ILL.

FOR SALE,

Water Gas Works,

SITUATED NEAR BOSTON, MASS.

Built to manufacture water gas for illuminating purposes, with a capacity of 300,000 feet of water gas per day. Completely fitted with meter, purifiers, holder, exhausters, boiler, engine, blowers, retorts, pipes, and all the necessary machinery to manufacture water gas. These works can be readily and cheaply changed to manufacture 100,000 feet of coal gas per day. Owing to a recent act of the Legislature of Massachusetts, the manufacture of gas containing over 10 per cent. of carbonic oxide is prohibited, and in consequence thereof these gas works are for sale, as a whole or in parts, at less than one-third the original cost. Address

A. H. SODEN,
527-2t 116 Water St., Boston, Mass.

Iron Sponge

AND

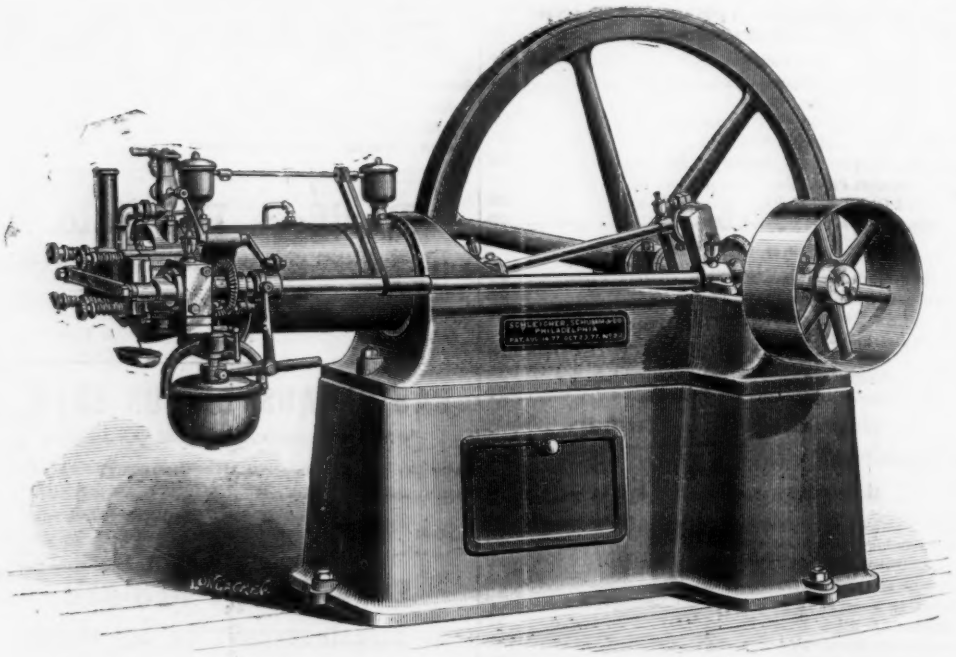
GAS EXHAUSTERS.

CONNELLY & CO.,

No. 407 BROADWAY, NEW YORK CITY

SILENT GAS ENGINE.

Always Ready to be Started, and to give at once Full Power.



NO STEAM TO MAKE OR MAINTAIN.

NO COAL NO ASHES NO DIRT

NO FIRE NO DANGER NO EXTRA NSURANCE

NO GAUGES, NO PUMPS NO LEAKAGE

ALMOST NO ATTENDANCE.

BURNS COMMON GAS.

AVERAGE CONSUMPTION PER HORSE POWER

21 1-2 Cubic Ft. Per Hour.

COSTS NOTHING WHILE STANDING LITTL WHILE RUNNING WITHOUT DOING WORK AND WHILE WORKING THE GAS IS PRECISELY REGULATED BY THE GOVERNOR IN PROPORTION TO THE POWER DEVELOPED

SIZES AT PRESENT OFFERED, **2, 4 and 7 H. P**

LARGER SIZES TO ORDER.

THE NEW OTTO SILENT GAS ENGINE.

Unexcelled for Convenience and Economy in running Gas Exhausters, Tar and Ammonia Pumps, Hoists in Warehouses or Stores, Ventilating Theatres, Halls and Buildings, Driving Electro-Magnetic Machines,

And useful generally for all work of small stationary steam engines. Where work is intermittent, trouble with a steam boiler and engine is at its maximum, but is at its minimum with a gas engine. For particulars, prices, etc., apply to

SCHLEICHER, SCHUMM & CO.,
3045 Chestnut Street, Philadelphia.

THE PROCESS FOR REMOVING

THE

Carbonaceous Incrustations

FROM

THE INTERIOR SURFACE OF CLAY RETORTS.

PATENTED BY THE LATE GEORGE W. EDGE.

The subscriber, having secured the title to the *above patent*, is prepared to negotiate with gas companies for its use on very reasonable terms. The great economy of this process has been thoroughly demonstrated in this country and in England, and is the only method so far discovered that removes this troublesome accumulation expeditiously and without injury to the retorts. Address

D. D. FLEMMING, Jersey City Gas Works,
JERSEY CITY, N. J.

NOW READY,

VOLUME II. OF

King's Treatise on Coal Gas

BOUND IN CLOTH. PRICE, $10.

A. M. CALLENDER & CO

42 Pine Street, N. Y.

Parson's Steam Blower,

FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER,

FOR UTILIZING COAL TAR AS FUEL.

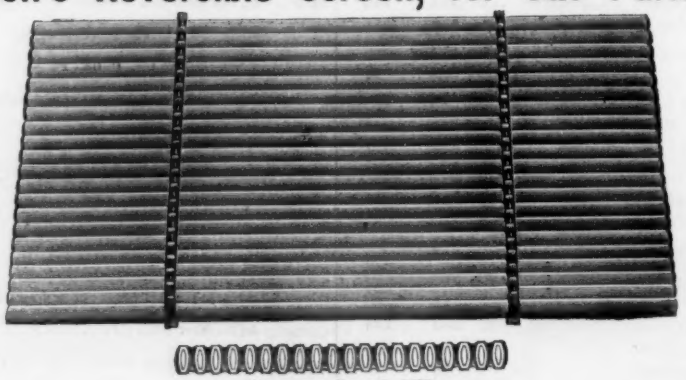
PARSON'S AIR JET TUBE CLEANER,

FOR CLEANING BOILER TUBES.

These devices are all first-class. They will be sent to any responsible party *for trial*. No sale unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY.

H. E. PARSON, Supt., 42 PINE ST., N. Y.

Church's Reversible Screen, for Gas Purifiers.



PATENTED JULY 9, 1878.

Reversible, Very Durable, & Easily Repaired. Oval Slats, with Malleable Iron Cross Bars.

Apply to CONTINENTAL WORKS, Greenpoint, N. Y., or DAVIS & FARNUM MANUFACTURING CO., Waltham, Mass., who are authorized to build them, or to

GEORGE D. CABOT, Agent Lawrence Gas Co., Lawrence, Mass.

REFERENCES:—Lawrence Gas Co., Lawrence Mass.; Roxbury Gas Co., Roxbury, Mass.; Newport Gas Co., Newport, R. I.

AMERICAN METER CO.,

SOLE MANUFACTURERS OF THE

"ECONOMY" GAS STOVES

In presenting these stoves, we would respectfully say that after a most thorough and lengthy investigation of the different apparatus used for cooking by gas, it is with the utmost confidence that we can recommend our new and improved "Economy" Cooking stoves as being the most efficient, economical, and durable gas stoves ever offered to the public. Efficient from the rapidity with which they do their work. Economical as to the consumption of gas, and Durable from the quality of material and workmanship employed in their manufacture. The wide-spread reputation which we enjoy for producing only first-class articles in all our manufactures, we feel confident will attach itself to our "Economy" Gas Stoves. AMERICAN METER COMPANY.

NO EXTRA CHARGE FOR NICKEL-PLATED FITTINGS.

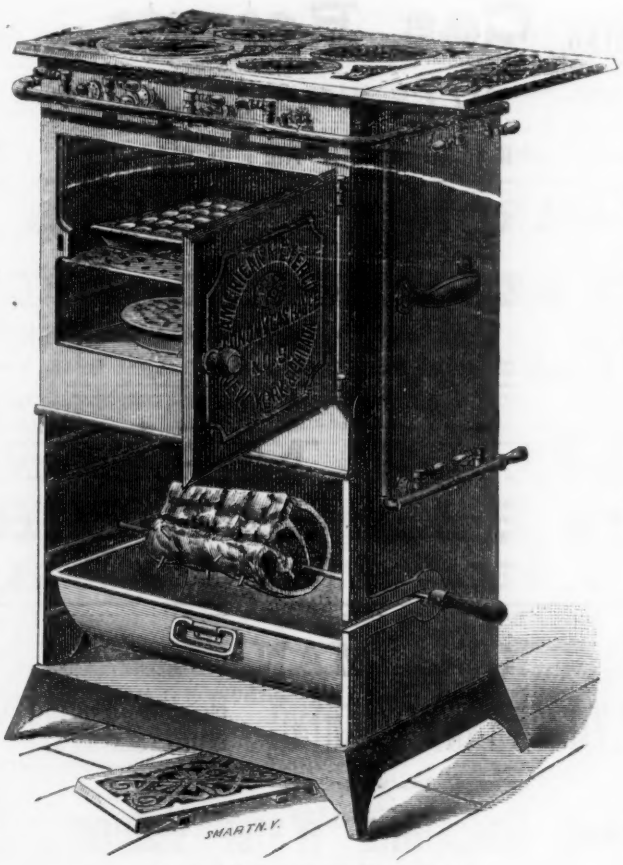
UNEQUALED ECONOMY OF GAS FOR THE QUANTITY OF COOKING DONE.

A THOROUGHLY DIFFUSED HEAT THROUGHOUT THE WHOLE STOVE.

ALL THE OVENS TIGHT, JACKETED, AND PERFECTLY VENTILATED.

PATENT SMOKELESS GAS-AND-AIR BURNERS OF SUPERIOR POWER FOR BOILING, FRYING, STEWING, PRESERVING, JELLYING, HEATING SAD-IRONS, ETC.

GENERAL AND SPECIAL SUPERIORITY IN ALL COOKING OPERATIONS.



No. 9.—"Economy" Gas Range.

A BROILER UNDER THE FIRE WITHOUT SMOKE.

AN OPEN ROASTER UNDER THE FIRE WITHOUT SMOKE.

UNSURPASSED EXCELLENCE OF WORKMANSHIP AND FINISH.

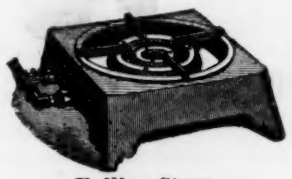
DOWNWARDLY RADIATING BURNERS OF GREAT POWER.

RADIATING BURNERS THAT CONSUME THE GAS OF ANY LOCALITY WITHOUT ODOR OR SMOKE.

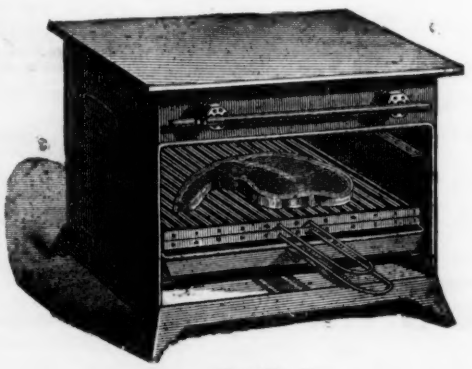
BURNERS THAT ARE PRACTICALLY INDESTRUCTIBLE FROM TIME OR USAGE.

THEY ARE MADE IN ALL SIZES, TO MEET THE REQUIREMENTS OF FAMILIES.

Will Burn at a Low Pressure.

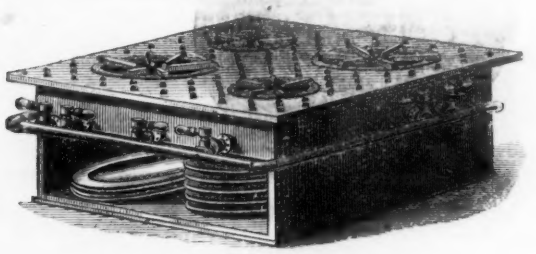


Boiling Stove.



Gas Broiler.

All Qualities of Gas can be Used.



Hot-Plate.

With these Stoves all the operations of cooking can be carried on at the same time, thus avoiding annoyance and trouble.

SEND FOR ILLUSTRATED CATALOGUE.

AMERICAN METER CO., New York and Philadelphia.

J. H. CAUTIER & CO.,
CORNER OF
GREENE AND ESSEX STREETS,
JERSEY CITY, N. J.
MANUFACTURERS OF
Clay Gas Retorts,
Gas House Tiles,
Fire Bricks, Etc. Etc.
Ground Clay, Fire Brick and Fire Sand in Barrels,
J. H. GAUTIER.
393-1y C. E. GREGORY
T. B. GAUTIER.

BROOKLYN
Clay Retort & Fire Brick Works,
(EDWARD D. WHITE & CO.)
Manufacturers of Clay Retorts, Fire Brick, Gas House and other Tile.
VAN DYKE, ELIZABETH, RICHARDS & PARTITION STS.
Office, 88 Van Dyke St., Brooklyn, N. Y.

LACLEDE
FIRE BRICKS AND
GAS RETORT WORKS
CHELTENHAM, MO.
Hand and Machine made Retorts and Settings, Superior Fire Bricks for Siemans Gas and Glass Furnace. Bricks and Tiles for Whitwell's Hot Blast Ovens, Blast Furnace and Cupola Tiles, Etc.
Fire Bricks and Tiles
of all shapes and sizes.
Glass Pot Clay. Fine Ground Clay and Fire Bricks. Sewer Pipe, Etc.
901 Pine Street, St. Louis, Mo.
642—

ESTABLISHED IN 1845.
B. KREISCHER & SONS,
OFFICE FOOT OF HOUSTON ST., E.R., N.Y.
Gas Retorts,
TILES, FIRE BRICK.
AND EVERYTHING IN THE FIRE CLAY LINE.

MANHATTAN
FIRE BRICK & ENAMELLED CLAY
RETORT WORKS.
ADAM WEBER.
CLAY GAS RETORTS
AND RETORT SETTINGS,
FIRE BRICKS, TILES, ETC.,
Office and Works, 15th Street and Avenue C., N. Y.

Borgner & O'Brien,
MANUFACTURERS OF
CLAY GAS RETORTS
AND RETORT SETTINGS,
FIRE BRICKS, TILES, ETC.
23d St., Above Race,
PHILADELPHIA.
TWENTY YEARS' PRACTICAL EXPERIENCE.

Works, LOCKPORT, PA.
GARDNER BROTHERS,
—ESTABLISHED 1864.—
Works, MT. SAVAGE JUNCTION, MD.
CLAY GAS RETORTS, RETORT SETTINGS, FIRE BRICK, TILES, Etc.
MINERS & SHIPPERS OF FIRE CLAY. OFFICE, 116 SMITHFIELD ST., PITTSBURGH, PA.
C. H. SPRAGUE, No. 13 EXCHANGE PLACE, BOSTON, MASS., Agent for the New England States.

OFFICE, 418 to 422 East 23d St., New York. ESTABLISHED 1856. WORKS, PERTH AMBOY, NEW JERS
HENRY MAURER,
Excelsior Fire Brick & Clay Retort Works
CLAY GAS RETORTS, BENCH SETTINGS, FIRE BRICK, TILES, ETC.

CHAPMAN
VALVE MANUFACTURING COMPANY,
MANUFACTURERS OF
Steam, Gas, and Water Valves and Gates.
FIRE HYDRANTS,
WITH POSITIVE DRIP.
All Valves and Hydrants furnished with
Babbitt Metal Seats & Non-Corrosive Working Parts.
WORKS AT INDIAN ORCHARD, MASS.
Boston Office, 77 Kilby St. New York Office, 28 Platt St.
ALL WORK GUARANTEED.

LUDLOW
Valve Manf'g Co.,
OFFICE AND WORKS
938 to 954 River Street and 67 to 83 Vail Ave.
TROY, NEW YORK.

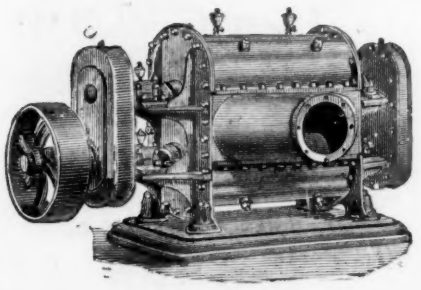
REFERENCES FURNISHED.
SEND FOR CIRCULARS.

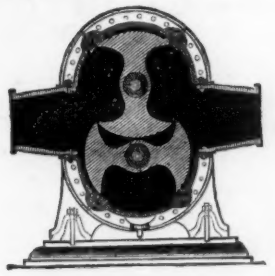
BRASS AND IRON SLIDE VALVES,
(Double and Single Gate, ¼ inch to 36 inch—outside and inside screws, Indicator, etc.,—for Gas, Water, Steam, and Oil.
HYDRAULIC MAIN DIP REGULATORS,
ALSO
FIRE HYDRANTS.

C. CEFRORER.
Manufacturer of
GAS BURNERS,
GAS HEATING AND COOKING APPARATUS.
FITTERS' PROVING APPARATUS, ETC.
No. 248 North Eighth Street, Philadelphia.

KING'S TREATISE
ON
COAL GAS.
Vol. I., Bound in Cloth, $10.
A. M. CALLENDER & CO., 42 Pine Street, N. Y.

P. H. & F. M. Roots'





IMPROVED GAS EXHAUSTER

With Engine on same Bed Plate, or without.

BYE-PASSES, GAS VALVES, GOVERNORS, ELBOWS, PIPE-FITTINGS, &C., FURNISHED TO ORDER.

P. H. & F. M. ROOTS, Patentees and Manufacturers, **CONNERSVILLE, IND.**

S. S. TOWNSEND, General Agent, 6 Cortland St. and 8 Dey St., N. Y.
JAS. BEGGS & CO., Selling Agents, 8 Dey St., N. Y.
WM. COOKE, Selling Agent, 6 Cortland St., N. Y.

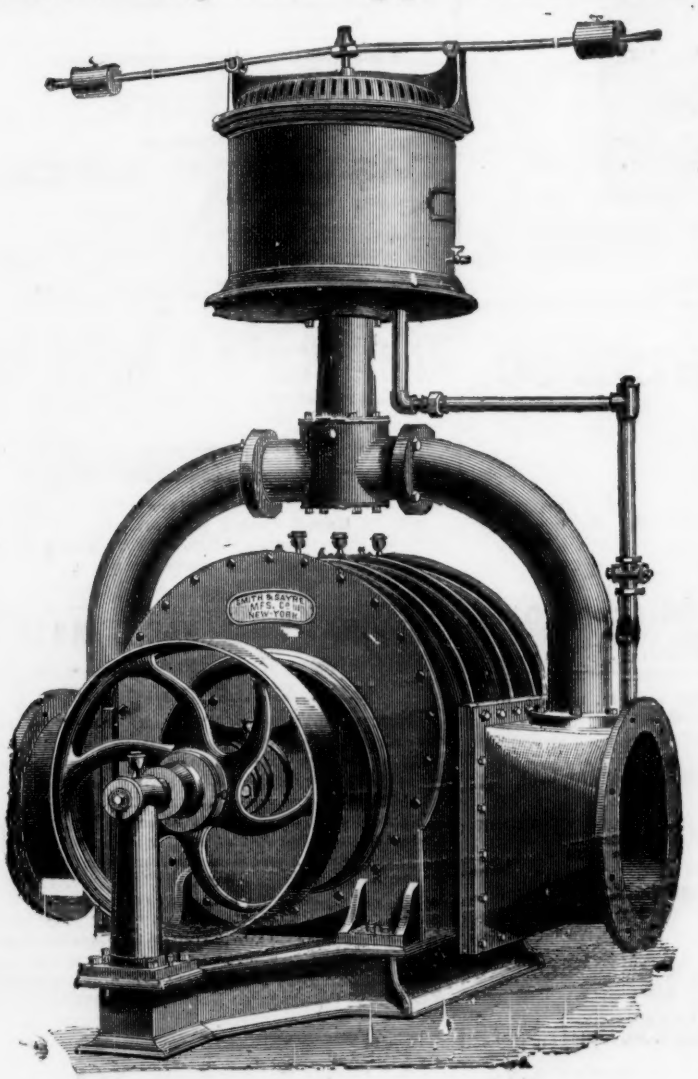
Send for Illustrated Catalogue and Price List.

SMITH & SAYRE MANUFACTURING COMPANY.

No. 245 BROADWAY, N. Y.

BUILDERS OF

Machinery and Apparatus for Gas Works.



MACKENZIE'S PATENT ROTARY AND STEAM JET GAS EXHAUSTERS, GOVERNORS, COMPENSATORS, BY-PASSES, CONDENSERS, WASHERS, SCRUBBERS.

ISBELL'S PAT. AUTOMATIC STREET PRESSURE GOVERNOR.

HIGH SERVICE GOVERNOR, GAS AND WATER VALVES, HYDRAULIC MAIN DIP REGULATOR, BENCH CASTINGS, Etc. PURIFYING BOXES, TOWER SCRUBBERS, WITH AUTOMATIC WATER DISTRIBUTOR. *ISBELL'S PATENT SELF-SEALING RETORT DOORS.*

Plans and Estimates for the Improvement, Extension, or Alteration of Gas Works, or for the Construction of New Works.

G. G. PORTER, *President* CHARLES W. ISBELL, *Secretary.*

MITCHELL, VANCE & CO.

Manufacturers of

CHANDELIERS

And Every Description of

GAS FIXTURES,

Also Manufacturers of

Fine Gilt Bronze and Marble Clocks, warranted best Time-keepers Mantle Ornaments, &c.

Salesroom, 836 BROADWAY.

NEW YORK.

Special designs furnished for Gas Fixtures for Churches Public Halls, Lodges, &c.

Portland Cement,
Roman Cement.
Keene's Cement
Sellars Gas Cement.

English Fire Brick, No. 1.
" Silica Fire Brick.

IMPORTER

S. L. MERCHANT

41 Broadway, New York,
Just below Trinity Church. 344-1y

Remit 35 cents in postage stamps for new Treatise on Portland and Roman Cement, showing how to mix it and how to use it.

F. O. NORTON,

MANUFACTURER OF

Hydraulic Cement

Specially adapted for gas works. Under water it is capable of giving better results than Portland or any other cement.

92 Broadway, New York.

G. W. DRESSER, C.E.,

Member American Society Civil Engineers.

CONSULTING ENGINEER

ON ALL MATTERS PERTAINING TO

Gas Manufacture

AND THE UTILIZATION OF

RESIDUAL PRODUCTS

"How to Burn Gas."

Under this title a neat little book has been issued containing the paper of Mr. Jas. Somerville, as read at the last meeting at Cincinnati, together with a table, taken from Prof. Chandler's lecture, showing the loss of light resulting from the use of shades, etc., of different kinds of glass.

The book is intended for sale to Gas Companies to distribute gratuitously among consumers. If Gas Companies can induce their consumers to use better burners and shades, one-half of the fault-finding will cease.

The price is $10 per thousand. Orders may be sent to the office of this Journal.

Preserve the Journal!

We will furnish to our subscribers an important article for *preserving in a convenient form*, the numbers of the Journal as it is issued at the very low price of $1.25. Sent either by Express or Mail, as directed.

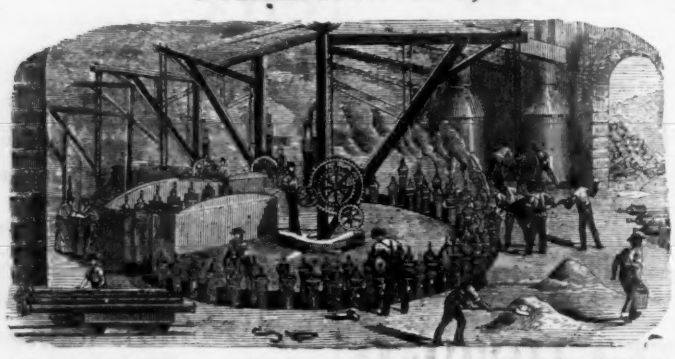
By mail the postage will be 20 cents, which will be added to the price of the Binder. Send orders to

A. M. CALLENDER & CO.
42 Pine Street, Room 18 New York.

A. H. M'NEAL,

BURLINGTON. N. J,

Flange-Pipes



General Foundry Work.

CAST IRON PIPES

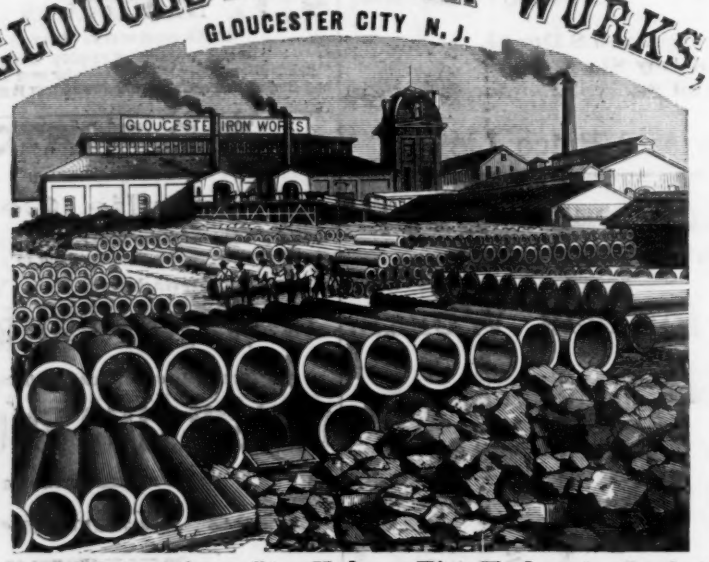
FOR WATER AND GAS.

DAVID S. BROWN, Pres.
BENJAMIN CHEW, Treas

JAS. P. MICHAELSON, Sec.
WM. SEXTON, Supt.

GLOUCESTER IRON WORKS,

GLOUCESTER CITY N. J.



Cast Iron Gas & Water Pipes, Stop Valves, Fire Hydrants, Gasholders. &c.

Office No. 6 North Seventh Street, Philadelphia.

ESTABLISHED 1856.

WARREN FOUNDRY AND MACHINE CO.,

WORKS AT PHILLIPSBURGH, N. J.

NEW YORK OFFICE, 153 BROADWAY.

Cast Iron Water and Gas Pipe

FROM TWO TO FORTY-EIGHT INCHES DIAMETER.

ALSO ALL SIZES OF

FLANGE PIPE for Sugar House and Mine Work.

Branches, Bends, Retorts, Etc., Etc. 436-1

SCIENTIFIC BOOKS.

We are prepared to furnish to GAS MANAGERS nd others interested in the topics treated of, the fol lowing Books, at prices named :

GAS MANUFACTURE, by WILLIAM RICHARDS. 4 to, with numerous Engravings and Plates, in Cloth binding. $12.

THE GAS ANALYST'S MANUAL, by F. W HARTLEY. $2.50.

ANALYSIS, TECHNICAL VALUATION, PURIFICATION and USE OF COAL GAS, by Rev. W. R. BOWDITCH, M. A., with Engravings. 8 vo., Cloth. $4.50.

NEWBIGGING'S HANDBOOK, by THOMAS NEWBIGGING, C. E. $3.75

GAS CONSUMERS HAND BOOK, by WM. RICHARDS, C. E. 18 mo. Sewed. 20 Cents.

GAS CONSUMERS MANUAL, by E. S. CATHELS, C.E. 10 Cents.

PRACTICAL TREATISE ON HEAT, by THOMAS BOX. Second edition. $5.

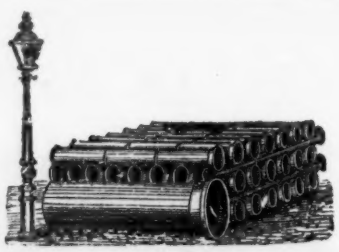
AIR AS FUEL, OR PETROLEUM AND OTHER MINERAL OILS UTILIZED BY CARBURETTING AIR, by OWEN C. D. ROSS, Member Institute Civil Engineers. 8 vo. Cloth. $1.50.

FODELL'S SYSTEM OF BOOKKEEPING FOR GAS COMPANIES. $5.

The above will be forwarded by Express, upon receipt of price.

We will take especial pains in securing and forwarding any other Works that may be desired, upon receipt of order. All remittances must be made by Check, Draft, or Post Office Money Order.

A. M. CALLENDER & CO.,
Room 10, No. 42 Pine St., N. Y.



R. D. WOOD & CO.,

PHILADELPHIA.

MANUFACTURERS OF

CAST IRON PIPE

FOR GAS AND WATER

Lamp Posts, Valves, Etc.

Mathew's Pat. Anti-Freezing Hydrants,

400 Chestnut Street.

JAMES MARSHALL & CO.

Franklin Foundry and Pipe Works,

MANUFACTURERS OF

GAS, WATER, AND OIL PIPES

Works, 18th, 19th, 20th and Railroad Street.
Office, No. 23 Nineteenth Street.

Pittsburgh, Pa.

N.B.—Pipes from 3-inch and upwards cast in 12 ft. lengths.
☞ Send for Circular and Price List.

BERGEN IRON WORKS.

R. A. BRICK,

MANUFACTURER OF

CAST IRON PIPES,

FOR WATER AND GAS,

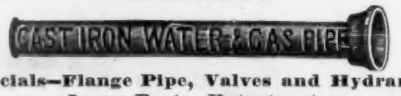
Valves, Fire and Dock Hydrants,
Lamp-Posts and Flange Work,

WILLIAM W. CAMPBELL, Selling Agent,
Office, 85 Liberty St., N. Y.

Mellert Foundry & Machine Co.,

Limited. Established 1848.

MANUFACTURERS OF



Specials—Flange Pipe, Valves and Hydrants, Lamp Posts, Retorts, etc.

Machinery and castings for Furnaces, Rolling Mills, Grist and Saw Mills, Mining Pumps, Hoists, etc.

ARNOLD MELLERT, Supt., READING, PA.

NATIONAL COAL GAS COMPANY.

320 Broadway, N. Y., Rooms 50, 51 & 52.

H. P. ALLEN, President.

The process known as GWYNNE-HARRIS, but from later most essential improvements, more appropriately called the ALLEN-HARRIS, or AMERICAN HYDROCARBON process for making "Water Gas," by the decomposition of superheated steam, in fire-clay retorts, set similarly to those in Coal Gas Works, is an established success. More than One Hundred Million cubic feet of gas have been made under this process, and for *permanency* and *brilliancy*, as well as economy both to the manufacturer and consumer, it is superior to any gas made by the old, or any other method.

Our process is *not intermittent* but continuous. The steam and the oil are admitted into the retorts by gauge cocks, and run for days without change. All the materials required, besides the steam, are 17 lbs. of Anthracite coal and about 3½ gallons of Petroleum or Naphtha, per 1000 feet of brilliant gas.

Rights for sale. Inquire of the President.

HERRING & FLOYD,

Oregon Iron Works,

738, 740, 742 & 744 Greenwich St., N. Y.

Practical Builders of Gas Works,

MANUFACTURERS OF

ALL KINDS OF CASTINGS

AND

APPARATUS FOR GAS-WORKS.

BENCH CASTINGS
from benches of one to six Retorts each.
WASHERS: MULTITUBLAR AND AIR CONDENSERS; CONDENSERS; SCRUBBERS
(wet and dry), and
EXHAUSTERS
for relieving Retorts from pressure.
BENDS and BRANCHES
of all sizes and description.

FLOYD'S PATENT
MALLEABLE RETORT LID.

PATENT
SELF-SEALING RETORT LIDS.

FARMER'S
PATENT BYE-PASS DIP-PIPE.

SABBATON'S PATENT
FURNACE DOOR AND FRAME.

BUTLER'S
COKE SCREENING SHOVELS.

GAS GOVERNORS,
and everything connected with well regulated Gas Works at low price, and in complete order.

SELLER'S CEMENT
for stopping leaks in Retorts.

N. B.—**STOP VALVES** from three to thirty nches—at very low prices.

Plans, Specifications, and Estimates furnished.

SILAS C. HERRING. JAMES R. FLOYD.

H. RANSHAW, Pres. & Mangr. T. H. BIRCH, Asst. Mangr.
WM. STACEY, Vice-Pres. R. J. TARVIN, Sec. & Treas.

STACEY MANUFACTURING CO.,

MANUFACTURERS OF SINGLE AND TELESCOPIC

GAS-HOLDERS

AND ALL KINDS OF

Cast and Wrought Iron Work

Used in the Erection of Gas and Coal Oil Works.

Foundry on MILL STREET; Nos. 33, 35, 37 and 39

Office and Wrought Iron Works on RAMSAY STREET Cincinnati, Ohio.

REFERENCE.

Cincinnati Gas-Light Co.	Baton Rouge, La., Gas Co.
Indianapolis Gas Co.	Saginaw, Mich., Gas Co.
Dayton, O., Gaslight Co.	Oshkosh, Wis., Gas Co.
Covington, Ky., Gas Co.	Peoria, Ill., Gas Co.
Springfield, O., Gas Co.	Quincy, Ill., Gas Co.
Terre Haute, Ind., Gas Co.	Champaign, Ills., Gas Co.
Madison, Ind., Gas Co.	Carlinville, Ill., Gas Co.
Kansas City, Mo., Gas Co.	Bowling Green, Ky., Gas Co.
Topeka, Kansas, Gas Co.	Hamilton, Ohio, Gas Co.
Burlington, Iowa, Gas Co.	Vicksburg, Miss., Gas Co
Nashville, Tenn., Gas Co.	Denver City, Col., Gas Co.

R. T. Coverdale, Eng'r Cincinnati, and others.

MORRIS, TASKER & CO.,

Limited,

Builders of Gas Works,

PHILADELPHIA, PA.

1842. DEILY & FOWLER 1881

LAUREL IRON WORKS.

ADDRESS, 39 LAUREL STREET, PHILA.

MANUFACTURERS OF

GAS HOLDERS,

SINGLE AND TELESCOPIC—WITH CAST OR WROUGHT IRON GUIDE FRAMES.

We are prepared to furnish Holders, Wrought Iron Roof Frames, Bench Castings, Condensers, Scrubbers, Purifiers, Drips, Bends, Tees, and all other Iron Work connected with Gas Works. We have built 12 gas works and 135 gasholders. Personal supervision given to the erection of all our work. Holders built at following places since 1868:

Lancaster, Pa. (2)	Indianapolis, Ind.
Williamsport, Pa. (3)	Jacksonville, Ill.
Bristol, Pa. (2)	Joliet, Ill.
Catasaqua, Pa.	Lawrence, Kansas.
Kittanning, Pa.	Jefferson City, N. O. La. (2)
Hazelton, Pa.	Algiers, N. O., La.
Freeport, Pa.	Kalamazoo, Mich
Huntingdon, Pa.	Buffalo, N. Y. (2)
Pittston Pa.	Ogdensburg, N. Y.
Bethlehem (S), Pa.	Waverly, N. Y.
Sharon, Pa.	Little Falls, N. Y.
Canton, Pa.	Penn Yann, N. Y.
Carlisle, Pa.	Watkins, N. Y.
Beaver Falls, Pa.	Coney Island, N. Y.
Annapolis, Md. (2)	Batavia, N. Y.
Parkersburg, W. Va.	Gloucester, N. J.
Lynchburg, Va.	Salem, N. J.
Stanton, Va.	Milwaukee, Wis.
Youngstown, O	Burlington, Vt.
Steubenville, O.	Hoosick Falls, N. Y.
Zanesville, O.	Attica, N. Y.
Mansfield, O.	Mount Holly, N. J.
Marion, O.	Mount Joy, Pa.
Bellcaire, O.	Rockaway Beach, L. I. (2)
Athens, O.	Zanesville, O. (2)
Barnesville, O.	Lancaster, O.
Newark, O.	Blackwell's Island, N. Y.
Columbus, O.	Waltham, Mass.
Franklin, Ind.	Dorchester, Mass.
Plainfield, N. J.	Wheeling, W Va.
Englewood, N. J.	Lansing, Mich.
Flemington, N. J. (2)	Flint, Mich.
Dover, Del.	Milton, Pa,
Pittsfield, Mass.	Galveston, Texas.
Meriden, Conn.	

BROWN & OWEN,

MANUFACTURERS OF

EVERY DESCRIPTION OF

Gas and Water Works Supplies.

Particular attention given to the alteration of old works. Estimates and Drawings furnished.

THOS. R. BROWN, R. PITT OWEN.
Late Chief-Eng. Phila. Gas Works.

Address all communications to

N. W. Cor. 12th and Noble Streets,
482-1y PHILADELPHIA.

The Kerr Murray Mfg. Co.,

THE LATEST IMPROVED

Gas Apparatus

AND

MACHINERY,

Wrought Iron Roofs and Bench Castings,

SINGLE LIFT AND TELESCOPIC GASHOLDERS.

FORT WAYNE, IND.

BARTLETT, HAYWARD & CO.,

ARCHITECTURAL IRON WORKS.

MANUFACTURERS OF

GAS HOLDERS, BENCH CASTINGS, MULTITUBULAR WATER AND AIR CONDENSERS, COMMON AND TOWER SCRUBBERS, ROTARY & STEAM JET EXHAUSTERS, WROUGHT IRON ROOF FRAMES.

MANUFACTURERS OF ALL DESCRIPTIONS OF GAS APPARATUS.

WORKS:

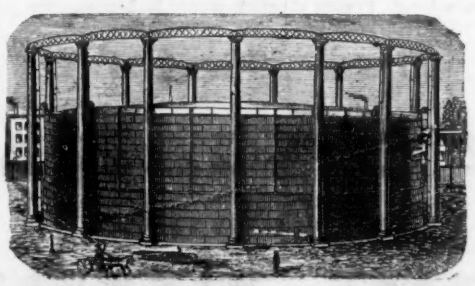
Cors. Pratt, Scott, McHenry, Ramsay and Bartlett Streets

BALTIMORE, MARYLAND.

Plans, Specifications, and Estimates furnished. Correspondence solicited. 467-1y

---

CONTINENTAL WORKS.



GASHOLDERS OF ANY MAGNITUDE.

T. F. ROWLAND, Proprietor,

GREENPOINT, BROOKLYN, N. Y

ENGINEER AND MANUFACTURER OF

GAS-HOLDERS,

CONDENSERS, SCRUBBERS, VALVES, PURIFIERS, RETORTS, and HYDRAULIC MAINS,

and all other articles connected with the Manufacture and Distribution of Gas. Plans and Specifications prepared and Proposals given for the necessary Plans for Lighting Cities. Towns, Mansions, and Manufactories.

P. MUNZINGER,

Engineer and Builder,

No. 1211 MARKET STREET, PHILADELPHIA, PENN.

BUILDER AND CONSTRUCTOR OF ALL KINDS OF GAS MACHINERY,

ON THE LATEST AND MOST IMPROVED PLAN.

Bench Castings, Condensers, Scrubbers, Purifiers, Centre Valves, Gasholders, Stop Valves, Etc., Etc.

Estimates and Drawings Furnished upon Application.

GAS COALS. GAS COALS. GAS COALS.

"SCOTT'S" OCEAN MINE

YOUGHIOGHENY GAS COAL.

W. L. SCOTT & CO., Proprietors, ERIE, PA.

This Colliery is located at Scott Haven, on the Youghiogheny River, Westmoreland County, Pa., directly adjoining the Penn Company's Youghiogheny Mine.

Over One Hundred and Fifty Thousand Tons of this Coal Sold in 1880

for delivery during the year ending March, 1881, distributed among forty different Gas Company's, including *every Company in New York City, Brooklyn, Jersey City, and Newark*, nearly every Company on the Hudson River as far as Albany and Troy, as well as all the prominent Companies on the Sound—at Boston and other New England ports.

The universal favor with which this coal has been received has induced Messrs. Scott & Co. to increase their already large facilities for meeting the wants of Gas Companies, giving to consumers an undoubted guarantee that delivery will be promptly made. Applications addressed to the undersigned will meet with prompt response.

Orders for delivery in New England can be addressed to our Boston office, No. 21 EXCHANGE PLACE, or P. O. Box 3003, BOSTON.

PERKINS & CO., General Sales Agents,

45 SOUTH STREET, N. Y.

THE GAS ANALYST'S MANUAL.

BY F. W. HARTLEY, A.I.C.E., M.S.E. E. & F. N. SPON, PUBLISHERS.

PRICE, $2.50.

CONTENTS. SECTION I.—The purposes of photometry. Standard light. Standard burner. Gas Works Clauses Act Amendment Act, 1871:—Regulations in respect of testing apparatus, mode of testing for illuminating power, and for sulphuretted hydrogen. Description of standard apparatus. The photometer room. Preparation of candles. Testing operations. Readings. Correction for gas consumpt. Corrections for candles' consumpt. Corrections for barometric pressure and temperature. Ordinary photometers. The inferential or jet photometers. To set the jet photometer at work. To rate the jet photometer.

SECTION II.—Duration and mode of testing in London, sulphuretted hydrogen, ammonia, sulphu compounds. Preparation of solutions. Fitting up. To set the apparatus at work. Analysis.

SECTION III.—Ammonia. Sulphuretted hydrogen. Carbonic acid. The Cooper's Tube, or Eudiometer. To calculate weight of sulphur. Harcourt's color test. A rapid and accurate methodof estimating sulphur in coal gas. Specific gravity. To find the specific gravity of dry gas. To correct the bulk and find the weight of gas.

APPENDIX.—Rules and tables to facilitate the calculations necessary in the determination of the illuminating value and degree of purity of coal gas. Photometry. Ammonia and sulphur. Proving of testing meters in London. The gas referees' cubic-foot measure. Times and mode of testing for pressure in London. Proposed standards of light.

A. M. Callender & Co., 42 Pine Street, N. Y.

S. MCCRICKART, Pres't. J. E. MCCRICKART, Mang'r.

THE FORT PITT COAL CO.,

Miners and Shippers of

COAL FORT PITT GAS COAL COKE

No. 337 Liberty Street,

PITTSBURGH, PENN.

ECONOMY OF GAS AS A FUEL

FOR

COOKING PURPOSES.

This is a small Pamphlet containing the Paper read by

MR. WILLIAM W. GOODWIN, OF PHILADELPHIA, PA.,

At the recent meeting of the American Gas Light Association.

IT IS INTENDED FOR GRATUITOUS DISTRIBUTION BY GAS COMPANIES AMONG THEIR CONSUMERS

Price, Twelve Dollars per Thousand.

A. M. CALLENDER & CO., No. 42 Pine Street, New York.

GAS COALS. GAS COALS. GAS COALS,

NEW YORK AND CLEVELAND
GAS COAL COM'Y
. Of Pittsburgh, Pa.

MINERS AND SHIPPERS OF

YOUGHIOGHENY GAS COAL.

This Company is prepared to furnish any amount of their justly celebrated, and acknowledged superior GAS COAL, to any point reached by railroad or navigation. on most favorable terms.

General Office—89 Wood Street,
PITTSBURGH, PA.

Branch Office—120 Water Street,
CLEVELAND, OHIO.

WILLIAM A. McINTOSH, President.
A. CARNEGIE, Vice-President.
W. P. DE ARMIT, Treasurer.
THOMAS AXWORTHY. Agent at Cleveland, Ohio.

351-1y

THE NEWBURGH

Orrel Coal Company,

Mines at Newburg, Preston County, W. Va.
Company's Office, No. 52 S. Gay Street, Baltimore, Md.
C. OLIVER O'DONNELL, Pres't. CHAS. MACKALL, Sec'y.
CHAS. W. HAYS, Agent in New York, Room 7, Trinity Building, 111 Broadway.

This Company offer their very superior Gas Coal at lowest market prices.

It yields 10,996 cubic feet of gas to the ton of 2,240 lbs. of good illuminating power, and of remarkable purity; one bushel of lime purifying 6,792 cubic feet, with a large amount of coke of good quality.

It has been for many years very extensively used by various Gas Companies in the United States, and we beg to refer to the Manhattan, Metropolitan, and New York Gas Light Companies of New York; the Brooklyn and Citizen's Gas Light Companies of Brooklyn, N. Y.; the Baltimore Gas Light Company of Baltimore, Md., and the Providence Gas Light Company, Providence, R. I.

Best dry coals shipped from Locust Point, wharves, and prompt attention given to orders for chartering of vessels.

324-1y.n

THE DESPARD COAL COMPANY

OFFER THEIR SUPERIOR

DESPARD COAL

To Gas Light Companies throughout the country.

Agent, ALFRED PARMELE, No. 32 Pine street, N. Y.
BANGS & HORTON, No. 31 Duane street, Boston.
Mines in Harrison County, West Virginia.
Wharves Locust Point, } Baltimore.
Company's Office, 15 German St., }

Among the consumers of Despard Coal, we name: Manhattan Gas Light Company, New York; Metropolitan Gas Light Company, New York; Jersey City Gas Light Company, N. J.; Washington Gas Light Company; Portland Gas Light Company, Maine

. Reference to them is requested. 294-

THE
PENN GAS COAL COMPANY

OFFER THEIR

COAL, CAREFULLY SCREENED,

AND PREPARED FOR

GAS PURPOSES.

Their Property is located in the Youghiogheny Coal Basin, near Irwin's and Penn Station on the Pennsylvania Railroad, and on the Youghiogheny River.

OFFICES

No. 209 South Third Street, Phil'a. 90 Wall Street, New York.

PLACES OF SHIPMENT.

Pennsylvania Railroad, Pier No. 2 (Lower Side).
Greenwich Wharves, Delaware River.
Pier No. 1 (Lower Side), South Amboy, N. J.

366-1y

CANNELTON COAL COMPANY

Miners of the celebrated **CANNELTON CANNEL,** acknowledged to be the *best enricher* produced in this country, yielding **10,000** cubic feet of **64.54** candle gas per ton of 2,240 pounds.

J. TATNALL LEA, Treasurer, P. O. Box 1747 Philadelphia.

SALES AGENTS: {C. & O. R'way Coal Agency, N. Y. **BENEDICT & DOWNS,** New Haven. {DANIEL W. JOB & CO., Boston. **DAVIS, MAYER & CO.,** Baltimore.

Chesapeake & Ohio Railway Coal Agency,

FOR THE SALE OF THE

SUPERIOR KANAWHA GAS COALS,
Also, SPLINT AND STEAM COALS,

From the Kanawha and New River Regions, on the line of the Chesapeake & Ohio R'way.

C. B. ORCUTT, SECRETARY. }
J. J. GORDON, SALES AGENT. } **OFFICE, 22 PINE STREET, N. Y.**

THE AMERICAN

GAS-LIGHT JOURNAL.

$3 PER ANNUM.

42 Pine Street, N. Y.

TYRCONNELL GAS COAL.,

MINED IN TAYLOR COUNTY, WEST VA.

Company's Office, 25 S. Gay St., Baltimore.

CHARLES MACKALL, Secretary.

CHARLES W. HAYS, Agent, Room 7, 111 B'way, N. Y.

SHIPPING POINT—Baltimore, Md.

This coal yields 10,000 cubic feet of Gas with an illuminating power of over 16 candles. Forty bushels of very superior Coke, with little Ash and scarcely any clinker 94-1y

---

English and Provincial Gas Coals,

THE BEST QUALITIES OF PROVINCIAL COAL FROM THE MINES AT

SYDNEY, GLACE BAY, AND LOUISBURG, C. B.

ALSO

Abram Co.'s Arley Gas Coal and Cannel, Higginson's North Ince Hall Gas Cannel, Townley & New Pelton Newcastle Coal.

DELIVERED AT ANY PORT IN THE UNITED STATES.

21 Exchange Place, Boston. PERKINS & CO., 45 South Street, New York.

INTERNATIONAL--1876--EXHIBITION.

The U. S. Centennial Commission

HAVE DECREED AN AWARD TO

HARRIS, GRIFFIN & CO.,

12th and Brown Sts., Philadelphia, and 49 Dey St., N. Y., U. S, A..

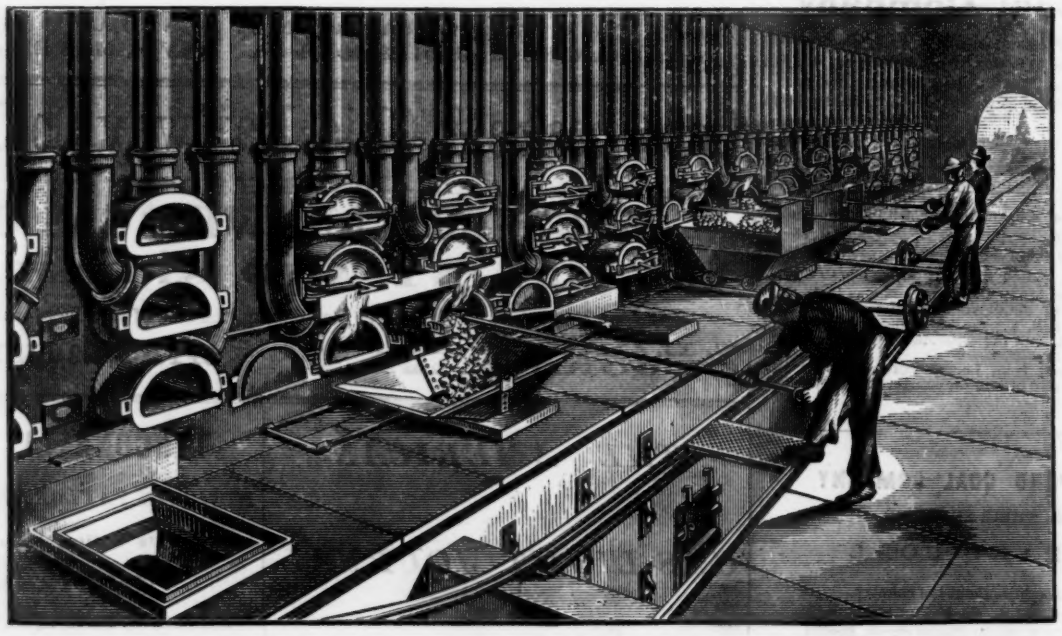
FOR THE FOLLOWING REASONS:

The Exhibit consists of a Series of METERS from the Largest Size Station Meters for the use of the MANUFACTURE OF GAS, to those for the use of the ORDINARY CONSUMER. The Instruments are WELL MADE, RELIABLE as to INDICATION, and embody a number of sundry improvements which, with the general character of the Exhibit, entitle the whole to commendation.

Attest—J. L. CAMPBELL, Secretary, pro-tem. Signed—A. T. GOSHORN, Director General J. R. HAWLEY, President.

Chas. F. Dieterich's Regenerator Furnace.

CAN BE ADAPTED TO ANY BENCH WITHOUT DISTURBING THE ORDINARY SETTINGS.



These Furnaces have been in operation at the works of the People's Gas Company, Baltimore, since June, 1878. A bench of 6's, with retorts 20in.x12in.x8ft. 6in., will burn off 1,350 pounds of coal in 3 hours. Twenty-five per cent. of the coke is sufficient to thoroughly burn off the charges.

State, city, and factory rights granted on reasonable terms. For full particulars apply to either

CHAS. F. DIETERICH, Eng'r People's Gas Co., BALTIMORE, MD.

& to FARMER, 61 Broadway, N Y., F. L. HAGADORN, 162 Beach St. Chicago, Ill., or HENRY J. DAVISON, 231 Broadway, N. Y.

T. C. HOPPER, Prest. WM. H. HOPPER, Vice-Prest. WM. N. MILSTED, Gen. Supt. and Treas. WM. H. DOWN, Sec.

AMERICAN METER COMPANY,

WET AND DRY GAS METERS. PRESSURE REGISTERS. METER PROVERS.
STATION METERS. PRESSURE & VACUUM REGISTERS. PORTABLE TEST METERS.
EXHAUSTER GOVERNORS. PRESSURE & VACUUM GAUGES. EXPERIMENTAL METERS.
DRY CENTRE VALVES. CRESSON GAS REGULATORS. AMMONIA TEST METERS.
GOVERNORS FOR GAS WORKS. MARSLAND WATER METERS. BAR AND JET PHOTOMETERS.

Manufactories:
512 W. 22d St., N. Y.
Arch & 22d Sts., Phila.

GAS STOVES—AMERICAN, FRENCH, & ENGLISH.
SUGG'S ILLUMINATING POWER METER.
SUGG'S "STANDARD" ARGAND BURNERS. ALSO NN AND TTT.
Wet Meters, with Lizar's "Invariable Measuring" Drum.
Sole Agents for Wm. Cowan's Automatic Pressure Changer.

Agencies:
37 Water Street, Cincinnati.
20 South Canal Street, Chicago.
810 North Second Street, St. Louis.
122 & 124 Sutter St., San Francisco.

HELME & McILHENNY,

Successors to Harris & Brother.

ESTABLISHED 1848.

PRACTICAL GAS METER MANUFACTURERS,

Continue as heretofore at the OLD ESTABLISHMENT, Nos. 1115 and 1117 Cherry Street, Philadelphia, Pa.

To manufacture Wet and Dry Gas Meters, Station Meters, Experimental Meters, Meter Provers, Centre Seals, Governors, Pressure Registers, Indicators, Photometers, and all kinds of Gas Apparatus; Also furnish all other Articles appertaining to the use of Gas Works.

From our long Practical Experience of the Business (covering a period of 33 years) and from our personal supervision of all Work, we can guarantee all orders to be executed promptly, and in every respect satisfactorily.

WILLIAM HELME JOHN McILHENNY.

WM. WALLACE GOODWIN, Prest. and Treas. WM. H. MERRICK, V.-Prest. H. DUMONT WAGNER, Supt. S. L. JONES, Sec. S. V. MERRICK, Asst. Sec.

THE GOODWIN GAS STOVE AND METER COMPANY,

Successors to W. W. GOODWIN & CO.

No. 1012, 1014 and 1016 Filbert Street, Philadelphia, Pa.

No, 142 Chambers Street, New York

MANUFACTURERS OF GAS STOVES FOR COOKING AND HEATING PURPOSES.

Dry and Wet GAS METERS, Station Meters (Square, Cylindrical or in Staves) Glazed Meters, King's and Sugg's Experimental Meters, Lamp Post Meters, Etc., Etc., Meter Provers (sizes 2, 5 and 10 feet), Pressure Guages of all kinds, Pressure Registers, Pressure and Vacuum Registers, Pressure Indicators (sizes 4 inch, 6 inch and 9 inch), King's Pressure and Vacuum Gauges, Dry and Wet Centre Seals, Dry and Wet Governors, Exhauster Governors, Photometers of all descriptions. Letheby's Sulphur and Ammonia Test Apparatus complete—also Testing and Chemical Apparatus of all kinds, and of the most perfect description, for all purposes relating to Gas.

Goodwin's Improved Lowe's Jet Photometer.

Special attention to repairs of Meters, and all apparatus connected with the business.
All work guaranteed first class in every particular, and orders filled promptly.

Review of Gas and Water Engineering.

ISSUED EVERY ALTERNATE FRIDAY.

Edited and Published by CHAS. W. HASTINGS, 8 Buckingham St., London, Eng

Each number contains articles in connection with the manufacture and supply of Gas; summary of latest intelligence on the subject of Electric Lighting; articles upon Water Supply; also on the Construction and Maintenance of Gas, Water, and Sewage Works.

Price, 10s., Postpaid.

The Gas and Water Companies' Directory.

Edited and Published Annually by CHARLES W. HASTINGS.

This Work gives a complete list of all Gas and Water Companies throughout England, Scotland, Ireland and Wales; date of formation, amount of capital and names of all officers, etc.; including carbon returns, prices paid for gas, dividends, etc.

Price, in Cloth Covers, 5s.; Paper Covers, 3s. 6d. Postage Extra.

Address, 8 BUCKINGHAM STREET,
Orders Received at this Office. LONDON, W. C., ENGLAND

NOW READY AND FOR SALE,

FODELL'S
System of Bookkeeping
FOR GAS COMPANIES.

Price $5, which should be sent either in Check P. O. Order or Registered Letter.

Blank Books, with printed headings and forms on this system, will be supplied to Gas Companies, by applying to W. P. FODELL Philadelphia, or

A. M. CALLENDER & CO
OFFICE GAS LIGHT JOURNAL, 42 Pine St., N. Y

CATHEL'S
GAS CONSUMERS MANUAL.

Enables every Gas Consumer to ascertain at a glance, without any previous knowledge of the Gas Meter, the quantity and money value of the Gas consumed. Also the best method of obtaining from Gas the largest amount of its light.

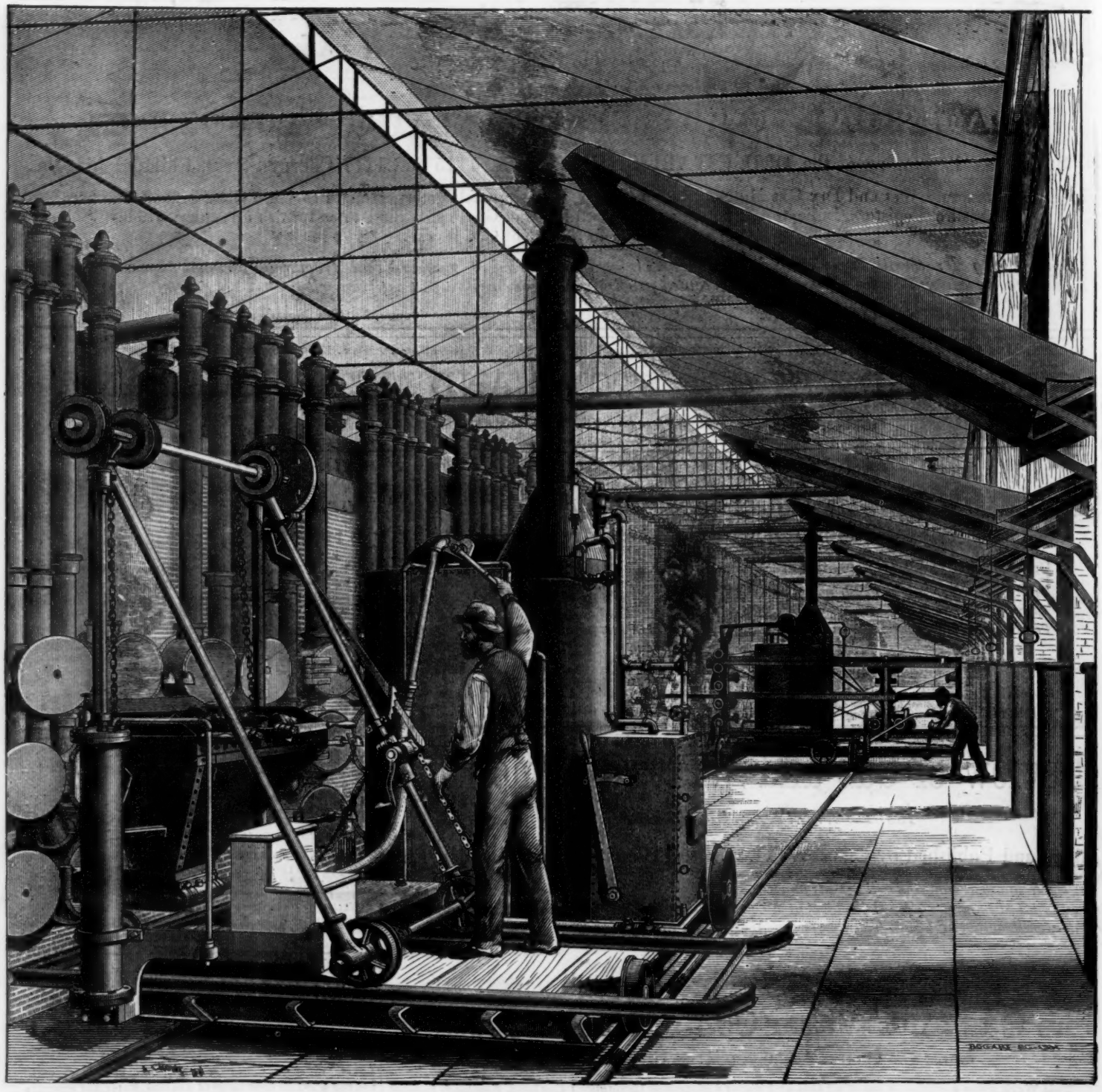
It will be to the advantage of Gas Companies to supply their Consumers with one of these Guides, as a means of preventing complaints arising from their want of knowledge in regard to the registration of the meters. For sale by

A. M. CALLENDER & CO
42 Pine Street, New York Room 19

A. Q. ROSS'

STEAM STOKERS.

Now in continuous and systematic operation at the works of the Cincinnati Gas Light and Coke Company, Cincinnati, Ohio, where for the past sixteen months they have been drawing and charging retorts at the rate of one every minute. Simple in construction, and easily operated by any intelligent man.



Address, A. Q. ROSS, Manager,

U. S. STEAM STOKING COMPANY, CINCINNATI, OHIO, U. S. A.

I.

pany,
te of